NATURE

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CONTENTS

	PAGE
The State and Wild Life	805
Darwin Misunderstood. By Sir Edward Poulton, F.R.S.	807
An Index to Scientific and Technical Constants. By Dr. S. C. Bradford	808
Properties of Matter in Modern Guise. By F. Ian G. Rawlins	810
Motor Spirit from Coal. By John L. Strevens and Arthur C. Cross	812
Plants of the Sand Dune and why they Grow There. By Prof. E. J. Salisbury, F.R.S.	814
Landscape at the Royal Academy. By L. C. W. Bonacina	818
Obituary Notices:	
Mr. T. H. D. La Touche. By G. H. Tipper	819
Prof. John Taylor	820
Mr. F. J. Gould	820
News and Views	821
Letters to the Editor:	
An Ethical Declaration for the Times.—L. L. Whyte	827
Carriers of Foot-and-Mouth Disease.—Prof. R. C. McLean	828
More Discoveries of *Australopithecus*.—Dr. R. Broom, F.R.S.	828
Gilding of Copper among the Pre-Columbian Indians.—Paul Bergsøe	829
A Colorimetric Method for the Estimation of Nicotinic Acid in Foodstuffs.—M. Swaminathan	830
Selective Oxidation as a Fundamental Principle in Metallic Protection.—G. J. Thomas and Laurence E. Price	830
Effect of Succinic Acid on the Respiration of Normal Human Muscle and Various Myopathies.—Dr. F. J. Stare, E. S. Gordon and M. J. Musser	831
Vitamin B_1 and Cocarboxylase.—Dr. S. Ochoa	831
Magnitude of Nuclear Forces.—Prof. Guido Beck	832
Mechanism of the Primary Photodissociation Processes of Organic Molecules.—Dr. Ernst Bergmann and Prof. R. Samuel	832
Band Spectrum of Silicon Monosulphide.—R. F. Barrow and Dr. W. Jevons	833
Fluctuation Noise in Thermionic Valves.—D. A. Bell	833
Elastic Constituent of Rubber.—Dr. T. C. Roberts	834
Food of the Partridge.—Dr. Walter E. Collinge	834
Cytology of Metamorphosis in the Culicinæ.—Prof. Charles A. Berger	834
Absorption of Growth-Promoting Substances by Cuttings.—T. H. Jackson	835
Probable Fossil Hail Impressions in Natal Coal Measures (Middle Ecca Series).—Leslie E. Kent	835
Heavy Electrons in Cosmic Rays.—Dr. E. J. Williams and E. Pickup	836
Illusion of Convergent Beams of Light.—A. H. Rosenthal	836
Research Items	837
Chemical Reactions Involving Solids	839
Dominion Tributes to Lord Rutherford	841
The Assessment of Nutrition	842
Science News a Century Ago	843
University Events	843
Societies and Academies	844

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The State and Wild Life

IN so far as science is organized knowledge, it is a reasonable assumption that it could best be attained by the organization of scientific workers for particular purposes. Such a view has received tardy recognition in Great Britain, where faith has rested upon individual effort unhampered by official allegiances (it has been nobly rewarded for its trust), and where State-controlled scientific research is still looked upon by many with a modicum of distrust. Indeed as regards the biological sciences, the influence of the State has made itself increasingly felt in directing scientific investigation only in recent years, through the creation of such bodies as the Medical Research Council, the Development Commission and the Agricultural Research Council, and there the touch-stone has been the benefit of the people through researches directly or indirectly of economic importance.

Other nations have found that State organization of biological research has been fruitful to science as well as to the people, and have developed far-reaching schemes which have become integral parts of the nation's activities. The extraordinary expansion of the United States Department of Agriculture is a case in point. Founded in 1862, the functions and work of the Department had so increased in variety and extent that, even before the Board (now Ministry) of Agriculture and Fisheries was established in England as an independent unit in 1889, it had already developed special "Divisions" each with a staff which concentrated its attention upon one particular set of problems, of chemistry, entomology, botany, forestry, pomology, animal industry, statistics. Under this policy of devolution there grew up in the U.S. Department of Agriculture an organization which has been of supreme importance for the wild life of the United States, and of which no counterpart exists in Great Britain.

On July 1, 1886, the Division of Ornithology and Mammalogy was established by law "for the promotion of economic ornithology and mammalogy, an investigation of the food habits, distributaries [? distributions] and migrations of North American birds and mammals in relation to agriculture, horticulture and forestry"[1]. It might be thought that such an investigation was limited in scope and was remote from the interests of the populace and from major problems of farming, but that has not been the experience of the United States. The work and contacts of the old Division so widened that in 1904 its place was taken by the Bureau of Biological Survey, with its own Divisions of Administration, Public Relations, Wildlife Research, Land Acquisition, Migratory Wildfowl, and Game Management, and with at the present moment a technical staff of some two hundred and fifty persons, most of whom are stationed at field headquarters in the various States.

It is pertinent to our inquiry into the relationship of the State to wild life to glance at the activities of the Biological Survey, for its functions reveal an unexpected scope and correlation of interests, along lines some of which might well be developed in Great Britain. "The Bureau of Biological Survey, the wild life service of the Federal Government, engages in research relating to the habits, economic status, and diseases of birds and other wild animals, including studies in the propagation of fur and game species; it acquires and maintains refuges for migratory birds and other forms of native fauna; conducts work in game management, under regional directors, including control of injurious species

and the administration of laws for the conservation of vertebrate wild-life (except fishes). Its work is undertaken in the interest of agriculture, horticulture, stock-raising, forestry, and recreation, and to meet the natural requirements of the wild-life itself. . . . It maintains more than 100 refuges in the United States, Alaska, Hawaii and Puerto Rico for the protection of birds and of game and other mammals, conducts educational and investigational work in enforcement of laws for wildlife conservation, and develops more effective methods for the control of stock-killing wild animals, destructive rodents, and injurious birds, cooperating with State and other organizations."[2]

Although problems of economic biology in the United States differ from those in Great Britain in vastness if not in essence, the question compels attention whether some organization such as has proved so successful in America would not further investigations necessary for the understanding of the wild life of this country in its human relations.

It must not be thought that the absence of organization implies that such investigations have been neglected. The Vole Commission of 1892, the work of W. E. Collinge and others on the food of birds, the botanical surveys of W. G. Smith, A. G. Tansley, W. Davies and others, the inquiries set afoot by the British Trust for Ornithology and the Bureau of Animal Population of Oxford, and the researches upon insects and parasites of importance to farmer and forester conducted independently or with the support of the Agriculture Research Council, these and many others have added their mite to the sum of knowledge. But the fact that the majority of such researches depend upon the initiative and isolated work of individuals, or are conducted by bodies the tenure of which rests upon the insecurity of private donations, tends to make the investigations casual, incomplete, and planned for the short rather than the long view.

This unsatisfactory position could be remedied and that at no great expense to the State. In his brief address to the meeting convened by the University of London Animal Welfare Society on March 22 to discuss "Man's Relation to Nature", Prof. F. A. E. Crew properly pointed out that almost everything we need for the creation of a biological service already exists, that it should consist of men and not of masonry, and that it should make the most of biological departments in the universities, of museums, and of institutions like the Bureau of Animal Population and the British Trust for Ornithology, all of which are actually or potentially workers in the field of ecology.

It would be a mistake to develop an independent biological survey, for the essence of its investigations is that they must not be independent, but must be linked up with the efforts already being made by the State for the benefit of the people, through agriculture, forestry, the preservation of food-stuffs and materials from animal pests, and so on. The botanists have been calling for a permanent Botanical Survey[3]; the interest and variety of the problems tackled by the severely limited staff of the Bureau of Animal Population at Oxford are referred to in another place (p. 822); the demand for the establishment of national parks and of Nature reserves in face of the steady encroachment of industry and human habitations upon the open spaces of the country; the possible effect upon fauna and flora; the acquisition by the State of vast areas for afforestation; these suggest some of the many problems that await the consideration of a Biological Survey. That some form of organization in these diverse and yet interrelated matters is desirable must be obvious to anyone familiar with the casual development of British economic biology.

In 1793 Pitt, with great foresight, established a Board of Agriculture with Sir John Sinclair as president, a chief object of which was to collect information respecting the agricultural conditions of each county. That Board came to an end in 1822 during a long period of agricultural depression, but the need for studying agricultural conditions, particularly in regard to wild life, still remains, although a new interpretation has been given to "agricultural conditions" by modern methods of botanical surveys and of precise analysis of animal populations in relation to climate, vegetation and other influences still unknown.

For the elucidation of all such problems of economic biology in Great Britain, we envisage a body organized, as in the United States, under the State departments dealing with agriculture, which will adopt, encourage, direct and initiate activities, botanical and zoological, bearing upon the relationship of plants and animals—the living environment—to the human population, and will keep in mind at the same time the interests of the wild life itself.

[1] From *Misc. Pub., U.S. Dept. Agric.*, No. 223.

[2] From "A History of Agricultural Experimentation and Research in U.S.A.—1607–1925". True, A. C., *Misc. Pub., U.S. Dept. Agric.*, No. 257 (1937).

[3] See Fenton, E. Wyllie, "The Need for a Permanent Organization for Undertaking Periodic Botanical Surveys of Great Britain", *Scot. Forestry J.*, **49**, 121–126 (1935).

Darwin Misunderstood

Charles Darwin, the Fragmentary Man
By Geoffrey West. Pp. xiii + 351 + 8 plates. (London: George Routledge and Sons, Ltd., 1937.) 15s. net.

THE author has evidently spent much time and labour in writing this life of Charles Darwin and presenting it in a moderate-sized volume of 351 pages, printed in a type pleasant to read, with eight illustrations, including three of Darwin (in 1840, 1854 and 1881), one of his wife and three of his ancestors. The list of "works quoted or otherwise utilised" on pages 333–342 is an indication of the ground which was traversed in its preparation, with the fruitful results shown in the excellent choice of significant passages for quotation.

The most unfortunate feature of the book is the word "fragmentary", given prominence in the title but only fully explained at the end, where on page 329 we read—"Werner Sombart has written of 'the fragmentary man' who is the type of the capitalist executive, seeing all in acquisitive terms, subordinating the whole to the part, making the quantitative aspect the total consideration till 'all else within him dries up' and 'everything about him becomes a wilderness, all life dies, all values disappear'." The author then proceeds to his preposterous conclusion: "The resemblance of this 'fragmentary man' to Darwin is evident. The business man lives for the acquisition of wealth; the Darwinian scientist for the acquisition of knowledge—each irrespective of human consequence."

Nothing in truth could be more unlike the Darwin of whom we know so much and feel that we love, than the type described in Sombart's embittered words—the Darwin who "for nearly forty years . . . never knew one day of the health of ordinary men", and yet in the hours spared from his scientific researches, had pleasant relationships with his poorer neighbours, taking an interest in their welfare, helping to found a friendly club and acting as its treasurer for thirty years, "keeping its accounts with minute and scrupulous exactness", and explaining the position to its members on Whit-Mondays when he received them in the garden. His friend the vicar wrote of him that in all parish matters he was an active assistant and that his liberal contributions were ever ready. Darwin also acted for some years as a county magistrate, and Major Leonard Darwin informs me that it was during the drive from one of the meetings that the creative thought upon divergence of character suddenly flashed into his mind.

In his "Memories of Down House"*, Major Darwin recalled with especial vividness a walk with his father and sister in a secluded valley beyond the "Sand Walk" at Down House, and how his father, moved by the peaceful beauty of the scene, said "that if he had to live his life over again he would make it a rule to let no day pass without reading a few lines of poetry", quietly adding that he wished he had "not let his mind go to rot so". On this Major Darwin wrote, recording his "firm conviction—a conviction which certainly was shared by all my brothers and sisters—that not only did my father thus give a decidedly erroneous impression of the changes which had taken place in his mind, but that the passages in his autobiography dealing with this subject have been constantly misunderstood and misinterpreted in the Press".

It is right to point out—and I am glad to emphasize it—that the author, again and again throughout the volume, creates an impression of Darwin which is entirely inconsistent with the "fragmentary man" described on page 329, and it is to be hoped that in any future issues the word and its definition will be omitted.

The conclusion conveyed on pages 121, 168 and 276, that Darwin was afraid of his father and treated him with an exaggerated deference, is not supported by the memories, written about 1877 or 1878, and quoted in the "Life and Letters"†—still less by the preceding paragraphs in which his son Francis records that "Charles Darwin had the strongest feeling of love and respect for his father's memory"; also—"his reverence for him was boundless and most touching"; and his daughter, Mrs. Lichfield, "describes him as saying with the most tender respect, 'I think my father was a little unjust to me when I was young, but afterwards I am thankful to think I became a prime favourite'." She had "a vivid recollection of the expression of happy reverie that accompanied these words, as if he were reviewing the whole relation, and the remembrance left a deep sense of peace and gratitude".

I am indebted to Major Leonard Darwin for the permission to quote the following words from a letter of November 12, 1937: "My memory of

* "Nineteenth Century," July 1929, pp. 118–123. An attempt to explain the misunderstanding referred to in this paragraph was made by the present writer in "Darwin and the 'Origin'", London, 1909, pp. 59–66, 79–83, 256–8.

† Vol. 1, pp. 11–20.

my father's attitude to his father was most certainly that he felt the strongest affection and indeed reverence for him. I myself do not remember a hint of any feeling that his father had been 'a little unjust' to him, as stated in my sister's excellent words on the situation." Also, referring to the author's words on page 168 about the purchase of a suitable property and Darwin's "diffidence towards his father in money matters", Major Darwin wrote: "At that date my father could hardly have earned enough to cover his expenses for a month, and all the capital expenditure on Down House must have come from the long and arduous labours of his father. Was it in any way surprising that he wanted to have a say in the matter?" It should be added that Darwin's only living son enjoyed reading the book, and fully appreciates the truthful picture of the exceptionally happy home at Down House.

In addition to the serious mistakes which have been here corrected, a few minor errors were noted: "draw" for drawn (p. xii), Christ Church "College" (p. 14), Floreat "Entomologie" (71), "Maderia" (96), "Arachnidæ" (196). F. W. Hope was not the "first Professor of Zoology at Oxford" (71), but founded the chair and nominated J. O. Westwood as its first occupant. It is also to be hoped that the words in which Fitzroy's suicide is described on p. 110 will be modified.

In conclusion, I am anxious to state my belief that the author has done valuable work which will bring comfort to many readers by giving them in a book of moderate size so complete an account of the life of Charles Darwin. E. B. POULTON.

An Index to Scientific and Technical Constants

International Annual Tables of Constants and Numerical Data:
Tables Annuelles Internationales des Constantes et Données numériques. Vol. 11 (Years 1931–1934). Part 1 (Sections 1–25). Pp. xiv + 492 + xv–xxv. n.p. Index to Vols. 6–10 (Years 1923–1930). Pp. xxiv + A48 + B304. 300 francs; £3. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co. Inc., 1937.)

COMMENCED in 1909 as an annual supplement to existing handbooks, in course of time this work has become in itself a comprehensive encyclopædia, or, actually, more than an ordinary encyclopædia, because new volumes are continually being added to keep the information up to date. The work constitutes a classified repertory containing references to the whole of the numerical values of physical and chemical constants, since determined, in the course of scientific investigations all over the world, with critical observations.

The realization comes to every scientific worker of experience of the overwhelming mass of information published every year in thousands of transactions of societies, Government and commercial reports and independent periodicals. In a single year perhaps three quarters of a million original scientific articles and fifteen thousand books are thrown into the weltering confusion of fact and theory. True progress must be founded on a basis of existing knowledge as wide and full as can be achieved. Study of what is known is the necessary preliminary to the discovery of the unknown, and, in that study, the student needs the help of the bibliographer in increasing measure as the sources of information become greater and more diverse. During a single life-time, the physical sciences have altered nearly out of recognition. Concurrently with an unprecedented increase in the technique of accurate measurement, the volume of knowledge has increased in an almost incredible ratio. There was a time when the chemist was both expected and able to read the whole of the significant literature of his subject. Now, he is fortunate if it is possible for him to keep abreast of a particular part of it, with the aid of a voluminous bibliographical literature, produced especially for that purpose.

A comprehensive bibliography, as the means of making a thorough study of existing information, has become an indispensable preliminary to the greater task of extending the boundaries of knowledge. Yet, incredible as it would seem, the practice of bibliography is still a thankless task. He who is willing to spend his time in collecting and classifying the records and results of the work of the experimentalist is looked upon askance by those for whom he works, and the products of his labours are rejected.

In libraries provided with elaborate subject catalogues, the reader prefers to ask for a book he knows, rather than look in the catalogue, in case there may be a better or a more recent work. The more extensive a bibliography, or, the more comprehensive an information service, the less advantage is taken of it. Smaller handbooks, and information centres of limited scope, lacking both

in organization and in resources, may be consulted, while comprehensive bibliographies, and bibliographical services based on the scientific study of the problems involved and an elaborate international organization, are almost unused.

If presented with a bibliography of even a hundred references to the literature of a special subject, many experimentalists are taken aback and demand instead a critical bibliography, forgetting that selection is a dangerous practice, except by omniscience, or, by the individual specialist himself.

An invaluable work, such as this before us, has been described as "ponderous volumes". Scientific workers are aware that nobody knows very much. But do we realize that we do not even know what is to be known? The bibliographical habit needs still to be acquired. The application of the well-worn principle of trial and error would indicate very soon that a few hours or days devoted to study of the literature would be repaid tenfold in saving of time and expense. If none were permitted to enter a laboratory before having acquainted themselves with the literature of their subjects, the need for critical bibliographies would disappear.

In the present work a happy mean has been drawn between the critical and the complete. For example, under the viscosity of mercury, Erk's accepted data, obtained by experiments in glass tubes, are quoted, while only a reference is made to the paper in which Tamann and Hinüber describe the higher values they obtained in copper capillaries, although these figures may yet prove to be correct.

The "Annual Tables" were founded at the Seventh International Congress of Chemistry, held in London, on the motion of Dr. C. Marie, who became their first editor and gave so much enthusiasm to the work. The task of collecting, classifying and editing the whole of the numerical data published each year on the physical properties and physico-chemical reactions of biological, chemical, industrial and mineral substances was entrusted to a single international organization, comprising representatives of national scientific associations under the auspices of the International Union of Chemistry and the International Council of Scientific Unions. The co-operating countries comprise: Argentine, Australia, Austria, Belgium, Brazil, Canada, Chile, Czechoslovakia, Denmark, France, Germany, Great Britain, Greece, Holland, Hungary, Italy, Japan, Norway, New Zealand, Poland, Portugal, Rumania, South Africa, Spain, Sweden, Switzerland, U.S.S.R., United States of America and Yugoslavia.

In 1936, by a resolution of the Twelfth Conference of the International Union of Chemistry, the management of the Annual Tables was entrusted to a managing board, having its offices in Paris, under the chairmanship of F. Joliot, with N. Thon as editor-in-chief and P. Auger as general secretary.

The first series of Annual Tables comprises volumes 1 to 10 and the years 1910–1930, to which two indexes have been issued, for volumes 1 to 5 and 6 to 10. These indexes are classified both alphabetically by names of substances and by formulæ. The texts are in two languages, French and English. The indexes are in French, with cross-references from English, German and Italian names. The access to the data contained in the tables by means of the indexes is very easy. In fact the work is in no way more difficult to use than the larger of the proprietary handbooks. It differs from them in being more comprehensive, up to date and in having critical notes.

The second series of Annual Tables, representing the years 1931–36, is being published in two forms: (i) in two volumes, 11 and 12, comprising the data for 1931–34 and 1935–36 respectively; and (ii) in the form of a series of "Monographs", each one containing the whole of the data appertaining to a section, or to several related sections, of the "Annual Tables". In the new series the format has been reduced from 4to to 8vo, which is certainly more convenient to handle.

The monographs vary in size from about thirty to eighty pages. They enable research workers to acquire, at reasonable cost, those sections of the tables in which they are more particularly concerned. Some of the monographs cover the periods 1931–34 and 1935–36 separately, while others include the whole period in one book. Those already issued deal with the subjects of rotatory power; Raman effect; radioactivity and nuclear physics; deuterium; dielectric constants; free energy, heat content, entropy and activity; heat conductance, specific heat; elasticity, compressibility, thermal expansion, density, viscosity, surface tension; vapour pressure, boiling points, gas laws; Volta effect, thermo-electricity, piezo-electricity, electrical conductivity of metals, supra-conductivity; paramagnetism, diamagnetism, ferromagnetism, Hall effect; electromotive forces, oxidation-reduction potentials; thermochemistry; molecular spectra and molecular structure; Faraday effect, magnetic and electric birefringence, photo-electricity; combustion and detonation of gases; scattering of light, reflection and refraction; conductance of electrolytes; melting temperatures; electrolytic and chemical equilibria.

The numerical data are compiled from original papers by eminent authors, selected solely on account of their competence in each particular branch of science and irrespective of nationality. The data are arranged in sections, according to

subject. Each section includes a survey of definitions and fundamental concepts. The data are classified by a rational system, which enables the desired information to be located with ease. They are accompanied by indications of the methods used in their determination and critical observations, which are of the greatest value. It is claimed that the complete literature is cited on every subject. While no bibliography yet produced has attained that perfection, this one is surely very comprehensive. Another commendable feature is that articles are not ignored because their titles do not indicate them to be sources of new constants. Moreover, the printing and compact arrangement of the material are everything to be desired.

The work is the only publication which furnishes periodically new physical, chemical, physiochemical and technical data, with comments and comprehensive references to the literature. In this way it renders services which are performed by no other collection of numerical data. It is designed for all who make use of quantitative values of the properties of substances and magnitudes occurring in biological, chemical or physical phenomena, whether in pure or applied science. The work should find a place in every library that caters for such needs, where it should be given a position on the shelves in the reading room, easy of reach and near a table, and not be relegated to an inaccessible book store. The individual monographs on special subjects are indispensable to scientific workers for their everyday use.

S. C. BRADFORD.

Properties of Matter in Modern Guise

Elasticity, Plasticity and Structure of Matter By Dr. R. Houwink. With a Chapter on the Plasticity of Crystals, by Dr. W. G. Burgers. Pp. xviii + 376. (Cambridge: At the University Press, 1937.) 21*s*. net.

THE title of this book, although a little lengthy, describes its contents with accuracy; it is essentially a study of structure approached through the phenomena of elasticity and plasticity. To give an adequate impression of the wealth of information which it contains is very difficult; perhaps the best way is to state that the substances discussed range from brass to bakers' dough. But, materials apart, the author (with the help of Dr. Burgers) has produced a remarkable treatise upon molecular physics, showing at every step how directly observable quantities like viscosity, tensile strength and so forth are connected with the type of structural unit in complex bodies, especially those of technological importance. It is the outlook of the physicist, sharply focused upon the chemist's problems. This point of view suggests something of the penetration of Kelvin, combined with a touch of Mendeléeff's power for anticipating the unknown.

The treatment is naturally to some extent synthetic, since the researches of a large number of workers are reviewed, and at frequent intervals their compatibility or otherwise is appraised. Though the bibliography is extensive, the authors have achieved far more than a mere account of the results obtained by other people. For example, Houwink has developed a theory to account for the difference between the theoretical and observed stress-strain relationships in resin macromolecules, akin to Smekal's *Lockerstellen*. He points out that the actual number of CH_2 'bridges' present may not be equal to the number theoretically possible; again, the chance that a single molecule can be added at each active spot of a growing complex obviously diminishes as the molecule about to be added itself begins to increase in size. Many factors of this kind occur in compounds of high molecular weight, and lead to discrepancies between the 'ideal' and the 'actual', as in crystallography.

In a different connexion entirely, the appearance of this volume is particularly opportune. This is on account of the interest which is now taken by those concerned with the technical side of art in the polyvinyls, lacquers and other rheological products. For them, these pages are of great significance. Thus, a relationship is suggested—on very reasonable assumptions—between the depth and width of a brush mark (in paint), the surface tension and the yield value, in order to obtain satisfactory levelling. In this, and a number of other instances, the property of thixotropy, or the re-coherence of a substance after shaking or stirring, is of consequence, and its effects receive detailed consideration.

It is almost impossible to imagine any investigation into the properties of existing materials, or the quest for new ones, which would not be advanced by consulting this book.

F. IAN G. RAWLINS.

Wonders of the Great Barrier Reef

By T. C. Roughley. Pp. xiii+282+51 plates. (Sydney and London: Angus and Robertson, Ltd., 1936.) 15*s*.

THIS is a popular book on living animals by a writer who is interested in them as such. It undoubtedly achieves its object, which is stated in the introduction, namely, the encouragement of interest in the Great Barrier Reef and the explanation of its magnificent fauna and its flora in such a way that the lay visitor can understand what he is looking at.

Mr. Roughley's style is of a pleasing simplicity touched here and there with a subtle humour. His calm narration of startling events, such as that of the diver who had his head in a shark's mouth and escaped (p. 226), might well serve as a reproach to the impassioned journalism found in some accounts of 'foreign parts' and their animals. Chapter xvii, "Wealth from the Reef", contains a useful summary of the fisheries and the value of their products, which range from vitamins to shirt buttons. One may be allowed a little doubt as to the incessant activities of killer whales mentioned on pp. 137 and 265.

Special mention must be made of the thirty-six coloured plates. Although unfortunately one or two are out of register, the remainder are examples of photographic reproduction of a very high order. The resemblance to life achieved by some is quite startling.

Mr. Roughley must be complimented on the production of a pleasing, interesting and informative book.

Food Values:

What they Are and How to Calculate Them. By the late Margaret McKillop. Revised and brought up to date by Elsie C. Mottram. Pp. xi+155. (London: George Routledge and Sons, Ltd., 1936.) 3*s*. 6*d*. net.

ON the death of Margaret McKillop in 1936, the publishers of this book entrusted its revision to Mrs. E. C. Mottram. Considerable alteration in format, as well as the addition of new tabular matter and the modernization of the text that one of the most rapidly moving of applied sciences demands, have resulted in as useful and handy a volume as could well be required by housewife or student of social science.

The reviser has, for the most part, eschewed controversial matter, confining herself to the statement of universally accepted dietetic principles and the publication of well-established figures for the composition and analysis of food. She has, however, drawn one false conclusion from the complementary investigations of the Mellanbys and of Bruce and Callow: it is certain that bone-meal, for example, or any other food source of assimilable phosphorus would be as effective as cod-liver oil, or other form of vitamin D, in combating any rachitogenic effect of brown bread. The remarks of the author on this matter savour a little of the 'faddism' that she so rightly condemns and otherwise rigorously eschews.

A. L. B.

Projective Geometry

By Prof. Boyd Crumrine Patterson. Pp. xiii+276. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 17*s*. 6*d*. net.

PROF. CRUMRINE PATTERSON declares that his motive in writing this text-book of projective geometry was "the feeling that a more complete discussion than is usual in elementary text-books is desirable". He thinks that in this way the supplementing of the text does not occur so often and the instructor has more time to devote to discussion, analysis and solution of problems.

The method adopted is that of synthetic geometry, and the development of this method is intuitional and based on the student's earlier knowledge of the elementary geometry of the schools. As distinguished from the usual elementary treatment, there is a careful distinction made between projective and non-projective ideas, while the principle of duality is developed in some detail. Further, the proofs of some of the earlier theorems are separated into steps and that of the fundamental theorem is built up on the concept of a net of rationality as a line. The theory of the imaginary elements is also introduced in some detail and is applied to various construction problems. Finally, there is a short discussion on the general projective group transformations on a plane and some of its sub-groups, of which the most notable is, of course, the metric group. In this way, the geometry of Euclid is shown to be a special case of projective geometry. There is material enough in the book for a full year's course.

Reactions of Hydrogen with Organic Compounds over Copper-Chromium Oxide and Nickel Catalysts

By Prof. Homer Adkins. Pp. ix+178. (Madison, Wis.: University of Wisconsin Press, 1937.) 3 dollars.

THE present volume deals with the development of high-pressure hydrogenation as a tool for use in synthetic organic chemistry and more particularly with the use of black copper-chromium oxide catalyst. Prof. Homer Adkins, his staff, and research students, have made this catalyst peculiarly their own: it is particularly suitable for the hydrogenation of aldehydes and ketones to alcohols, of esters to alcohols, of amides to amines, but is notably inactive for the hydrogenation of the benzenoid nucleus, so that it may be used to hydrogenate aryl compounds without saturating the ring. The procedure for the preparation of this catalyst is given in detail, as also the details of the pressure apparatus and the method of operation.

The bulk of the book is given over to the description of the various types of reaction studied, and the conclusions reached. It is essentially a practical treatise, and therefore all the more valuable; actual figures of temperature, time, quantities taken, yields, are all given.

The reviewer's treatment of it has been to write his name in it and put it on the shelf reserved for books frequently consulted; there will be many others who will do the same.

E. F. A.

Motor Spirit from Coal

By John L. Strevens and Arthur C. Cross

THE report of the Falmouth Committee has disappointed that large section of public opinion which hoped that motor spirit might be produced from coal in sufficient quantities to render Great Britain independent of foreign supplies, either in peace or in war. On the other hand, the report recognizes the immense amount of scientific activity that is being expended on the subject, and it is therefore opportune to consider the position as it is to-day.

Apart from the three branches of the carbonizing industry—gas, coking and low temperature—all of which produce a certain amount of spirit as a by-product, there are three commercially proved systems now at work for obtaining motor spirit from coal, (*a*) hydrogenation, (*b*) coal-oil distillation and (*c*) synthesis.

Research work has brought one of the authors (J. L. S.) into intimate contact with all these processes. He was in Germany in the early days of hydrogenation developments studying the subject in conjunction with the Dye Trust and Dr. Bergius, and supervised research work in this connexion at the Kaiser Wilhelm Institute. During the past two years he has enjoyed welcome entry to the plant, where he has observed the work carried on by the Synthesis group under Dr. Martin, whose immense industry at Oberhausen may be classed as one of the wonders of the modern technical world, and he is one of the technical advisers to the British group who have developed the Cannock process of coal-oil distillation and now have plants at Tipton and Erith.

It is estimated that since Dr. Bergius's original discovery, between £20,000,000 and £30,000,000 has been spent upon hydrogenation, which in Great Britain has culminated in the plant of Imperial Chemical Industries, Ltd., at Billingham. About £10,000,000 has been spent on synthesis since its inception and approximately £1,000,000 on coal-oil distillation processes.

Hydrogenation

Hydrogenation of coal and oil was first developed in Germany by Dr. F. Bergius and brought to Great Britain by the energy and foresight of the late Lord Melchett some twenty-five years ago. The process as operated to-day is the outcome of the pooling of all the patents and technical information acquired by international chemists and oil technologists in Great Britain, Germany and America, through the medium of International Hydrogenation Patents, Ltd. The part played by the coal industry in this development has been negligible, a fact which the industry will probably regret in time to come.

In the hydrogenation process a paste of coal and coal-oil is submitted to the intense action of hydrogen under high pressure (275 atmospheres at present at Billingham, though pressures up to 350 atmospheres are contemplated in future plants) in the presence of catalysts of the tin or molybdenum series, whereby partial liquefaction and reduction of the coal substance takes place and corresponding changes occur in the associated coal-oil. At the temperatures employed, simultaneous 'cracking' of the liquid constituents takes place and the ultimate result is the production of motor spirit and gas on one hand and an intractable residue of ash, catalyst, unconverted coal substance and heavy oil on the other.

Hydrogenation requires expensive plant of great strength and complexity to withstand the enormous pressure developed and the intensive action of the processed materials on the equipment. Once hydrogenation is effected, the rest of the plant, dealing with the hydrogenated and cracked oil products, is analogous to that of modern oil refineries.

Apart from the enormous capital cost of the plant, the complicated technique and working of the process—requiring as it does very large additional quantities of coal for power, hydrogen, steam and ancillary purposes—places a cost burden on the venture which is reflected in the very high production figure for the motor spirit obtained.

In 1936, 100,000 tons of coal were processed by hydrogenation at Billingham, and 325,000 tons of coal were utilized in the processing as well as 20,000,000 gallons of creosote and coal-oils. The production of 33,300,000 gallons of motor spirit was equivalent to 60 gallons for every ton of coal and oil utilized.

Although the progress of hydrogenation applied to bituminous coal and coal-oil mixtures has been a brilliant technical achievement, in Great Britain where the raw materials available are much more difficult to treat and much more expensive than they are in Germany, it seems unlikely that it can ever become an economic proposition, even with the excise discrimination intended for the express purpose of encouraging its development.

Any new hydrogenation plant in Great Britain would, according to the Falmouth Committee report, have to be designed to use coal only, as supplies of creosote or low-temperature tar are not available in sufficient quantities to provide for

another mixed coal and tar plant, and from an economic point of view it would have to be of a minimum capacity of 150,000 tons of petrol, such plant estimated to cost £8,000,000.

The only by-products of note obtained in the hydrogenation process are the propane-butane gases, which are marketed in the form of compressed gas for household and industrial use in isolated locations; for example, Calor Gas.

Coal-Oil Distillation

Coal-oil distillation is an entirely British process, organized and financed by W. B. Mitford and a group of colleagues. Eight years have been spent in bringing it to commercial completion. For the past two years much of the work has been done with the co-operation of Universal Oil Products, of Chicago, the well-known American oil cracking authority.

Coal-oil distillation *cum* cracking requires as its raw material a mixture of coal and coal-oil. In the coal-oil distillation plant of the National Coke and Oil Co. this mixture is converted into a coal-oil distillate which, because of changes brought about by its processing, is 'upgraded' into the class of naturally occurring oils amenable to the normal cracking operation. As a result this 'upgraded' distillate refines in a similar way to a medium quality petroleum, yielding a large percentage of high-grade motor spirit. Olefinic gases are also produced, from which further quantities of aviation and polymer spirits are obtainable.

This particular type of coal-oil treatment lends itself to development in widely scattered units, and is only limited by the availability of the coal-oil with which the coal needs to be pasted. If, according to a precedent already established, crude petroleum or its products are used in association with this coal-oil, then in the event of tax discrimination being exercised in favour of motor spirit produced from coal by this means, the possibilities of coal-oil distillation are limited only by the availability of such oils.

Why, it may be asked, is the oil from coal under this process changed into the character of a natural petroleum? This phenomenon has been discussed in scientific circles in the United States, Germany and Great Britain. The probable explanation is that the primary oil constituents of the coal have been 'soaked out' by the associated coal-oil and the deleterious material removed in the processing treatment. The coal-oil distillate 'upgraded' stock yields 43 per cent motor spirit when treated in a modern cracking plant. Thus by this process there has been obtained from coal and coal products (creosote, etc.) an oil stock that is, so far as motor spirit production is concerned, akin or similar to many natural crude petroleums. For the treatment of our huge supplies of suitable coal this development should prove eminently successful.

A standard unit for a process of this description consists of a coal-oil treatment plant having a daily throughput of 400 tons of 'paste' (50 per cent coal and 50 per cent oil), and a refinery with a capacity of 1,000 barrels of dephenolated 'upgraded' oil stock per day.

On the basis of a yield of 78 gallons of motor spirit per ton of stock treated, such a unit would produce 5,000,000 gallons of high octane product per annum. This yield is guaranteed by Universal Oil Products after testing the stock produced.

No account of coal oil distillation would be complete without reference to the smokeless fuel residuum, phenols, and rich gaseous by-products derived from the process.

The smokeless fuel is, on test, superior in every way to that obtained by ordinary dry methods of coal treatment. Apparently a proportion of oil absorbed in the coke residue imparts valuable properties which are reflected in its higher calorific value, complete combustibility, intense reactivity and high radiant heat value.

The phenols are equal to those produced from high-temperature coal tar, whilst the gas is rich in those higher hydrocarbons, making it particularly suitable for industrial metallurgical operations and as a motor transport fuel when compressed into portable cylinders.

Synthesis

Synthesis, or coal-gas treatment, is essentially a German development which has taken fifteen years to come to commercial practicability. It is based on experiments conducted over a number of years by Prof. F. Fischer and Dr. Tropsch, of the Kaiser Wilhelm Institute. This process forms part of the Four-Year-Plan now being carried out in Germany.

The synthetic processes are based on the well-known fact that oxide of carbon can be hydrogenated *at normal pressures* in the presence of catalysts of the eighth group of the periodic classification of elements to form a mixture of gaseous, liquid and solid hydrocarbons analogous to crude petroleum. The initial gases can be prepared in various ways from all types of carbonaceous material such as coal and coke, or from oil and gaseous hydrocarbons. Once a mixture of carbon monoxide and hydrogen in predetermined quantities (usually one part carbon monoxide to two parts of hydrogen) of the right degree of purity is available, the production of 'synthetic oil' is an open field.

One form of this development which has been brought to a state of almost technical perfection on an extensive commercial scale is operating in Germany under the name of the "Fischer" process,

but only small-scale experiments along similar lines have so far been carried out in Great Britain.

The synthetic products of the Fischer process consist of 9–10 per cent of gaseous hydrocarbons, 60 per cent 'straight' open-chain paraffinic motor spirit, 28 per cent high-grade Diesel oil fraction and 2–3 per cent wax, but slight modification in processing influences these proportions greatly.

Cost per Gallon

No attempt has been made in the Falmouth Committee report to compare the normal costs per gallon of producing motor spirit by the various processes examined. A fair estimate of the cost for the motor spirit produced by hydrogenation would be approximately 11*d.* per gallon, remembering that in all new plants it is difficult to assess the amortization figure. The octane rating of this spirit is 70 plus.

The outstanding feature of coal-oil distillation *cum* cracking is that from one ton of coal and one ton of coal-oil make-up there is produced 78 gallons of motor spirit. The approximate cost of this spirit, allowing average price for all other products, is 7·2*d.* per gallon, and the octane rating is 73–74.

A feature of synthesis is that 5½ tons of coal are required for the production of one ton of synthetic oil product. The yield of finished motor spirit is 40–45 gallons per ton of coal, and the cost may be placed at between 10½*d.* and 1*s.* 1½*d.* per imperial gallon. This range in the estimated price is advisable owing to the fact that in Germany the synthetic industry is very closely associated with the benzole industry and it is not easy to determine the net cost of the synthetic motor spirit. The best octane rating of this spirit is 62.

Limitations of the Processes

Each of the processes considered has its peculiar limitations which must be borne in mind in surveying the economic position.

In the case of hydrogenation, the capital cost is enormous. There are definite limitations to the percentage of coal in the coal-oil paste which it is advisable to treat. There are difficulties in the treatment of the residue and the recovery of the catalyst. It may be that the success of the process will ultimately rest upon the finding of an economic method of separating the catalyst from the residue and the means of handling it.

With coal-oil distillation *cum* cracking an important limitation lies in the supplies of creosote or similar coal-oil products at economic prices. In a state of national necessity the major portion of coal-oil produced would doubtless be made available for the preparation of home-produced motor spirit. If in the interests of the coal industry it were felt wise to make available, unhindered by tax, imported natural petroleum, the field for both hydrogenation and coal-oil distillation would be unlimited.

So far as synthesis is concerned, the motor spirit produced is of low octane rating. It is obvious that there would always have to be available 'upgrading' material at an economic price, such as benzole, alcohol, tetra-ethyl lead, iso-octane, etc. The synthetic process may always be limited by the high cost and availability of the necessary catalyst.

Advantages

The synthetic process is the only one so far developed which produces from coal a Diesel oil of first quality.

The coal-oil distillation process is the only one of the three under review which produces economically a large quantity of smokeless fuel of high radiant heat value and complete combustibility.

The valuable phenols so essential to the nation's needs in times of peace and war can only be obtained from coal distillation processes and the tar industry, and not from hydrogenation or synthesis.

Plants of the Sand Dune and why they Grow There*

By Prof. E. J. Salisbury, F.R.S.

THE vegetation of a sand dune is unique not only because of the rapidity of the changes that it exhibits but also because, from the manner of dune development, the phases present an arrangement in space corresponding to their sequence in time, so that the plant succession can be ascertained with certainty.

* From a Friday evening discourse delivered at the Royal Institution on February 4.

The embryo dune frequently begins around seedlings of either *Agropyron junceum* or *Ammophila arenaria*. Both are characterized by an important reaction to burial by sand, namely, that they are stimulated to grow through to the new surface. The projecting leaves by reducing wind movement not only shelter the surface from erosion but also bring about further deposition. *Agropyron junceum* can grow normally in 1·5 per

cent of salt and tolerate considerable periods of inundation by sea-water, whereas the marram grass cannot. But *Agropyron*, owing to its drooping habit, as contrasted with the erect habit of marram grass, is not so efficient a collector of sand and has much less capacity for vertical growth. Hence it only forms low dunes at low levels on the beach, whereas the marram grass is the successful pioneer at greater elevations and indeed is always the dominant species on English dunes in their early stages. It not infrequently brings about a rise of more than a foot a year in height, whilst its lateral spread may exceed 36 sq. ft. a year. Other grasses that play a part in the early stages are *Elymus arenarius* and *Festuca arenaria*. All these grasses spread by means of rhizomes from which at intervals tufts of leaves are given off above and roots below.

Measurements of a number of plants over a period of years indicates that both the pioneers *Agropyron junceum* and *Ammophila arenaria* have a remarkable capacity for rapid spread in their early stages of growth, which must render them peculiarly fitted for the occupation of a mobile habitat. The average areas occupied by twenty plants of *A. junceum* in the first few years of their development were: 1 sq.ft.; 5·7 sq. ft.; 18·4 sq. ft.; and 37·4 sq. ft.; the maximum annual increment, amounting to about 600 per cent, being exhibited during the second year's growth. The rate of radial extension gradually rises during the first three years to about a foot a year. The marram grass, though spreading at a slightly slower rate, namely, about 0·7 ft. per year, exhibits a maximum radial extension in the second year of growth which, in the plants studied, amounted to an average increase of area of no less than seventeen times. *Agropyron junceum*, through its greater toleration of sea water, can not only colonize at lower levels but also tends to occupy sand that is normally moister and hence firmer than that higher up where the marram grass is the dominant pioneer. The remarkable initial capacity for rapid spread of the latter may therefore be of some significance in its more mobile station.

The sand dune, though it may receive as much precipitation in the form of rain and dew as an inland situation, can be aptly described as an edaphic desert—a desert that is due, not to climatic but to soil conditions, since the coarse texture and very low organic content render sand a very poor retainer of water.

Data that I have obtained respecting the actual natural water content of dunes from a number of different localities around our coasts, shows that even after heavy rainfall the supply at the surface of a young dune rarely exceeds 10 per cent. Normally, however, the amount of water available to the plant is less than 4 per cent and frequently much less. For example, if there is a spell of dry, cold, windy weather the amount of water in the first two inches may fall to below 1 per cent, of which only a small part is available to the plant. On the other hand, the water content at six inches is normally between 4 and 5 per cent, and in warm sunny weather, which tends to promote rapid water-loss from the plant, there is an important compensatory phenomenon which plays a fundamental part in maintaining a fairly constant, if low, supply of water for these dune species. Owing to the large size of the sand particles and the dryness of the surface grains, these constitute a very bad conductor of heat. Hence the heat of the sun received by the superficial layers is not conducted downwards, as in normally moist soil, but results in very high surface temperatures being attained.

Excessive heating of the surface grains raises the temperature of the air in the interstices and the rising convection currents draw in warm moist air, from over the sea and adjacent tidal lands, into the interior of the dune. Here the moisture-laden air impinges upon the cooler sand grains and brings about a phenomenon known as internal dew-formation. Just because this is most pronounced in conditions of prolonged sunshine, internal dew-formation takes a most important role in stabilizing the moisture supply at a time when it might be expected to attain a minimum.

Compared with the shortage of water, the other factors adverse to plant growth, such as the mobility of the substratum, the changing level and the poverty in nutrients, are less inimical to plant life. Further, it must be emphasized that the high temperature attained by dune surfaces accentuates the effect of the small water content. We are not surprised that the number of these pioneer species is very few, but rather that these few can withstand the rigours of the habitat and even flourish despite them. In what way are these pioneer species equipped so that they can endure these very specialized conditions?

Owing to their extensive rhizomes, the risks consequent upon the mobile habitat are minimized. Further, a single plant thus exploits by its roots a very large volume of sand. Penetration of the sand by the rhizomes is facilitated by the structure of their apices, which are woody with a sharp point well suited for piercing the sand and capable of withstanding the inevitable abrasion. But the feature which more than any other fits these pioneers for growth on a dune is that they all possess leaves which automatically flatten out when their water content is high and curl into a cylinder when their water supply is low. On a dry windy day the leaves of the grasses appear

like narrow tubes split along one side, and this split widens or narrows in exact relation to the increase or diminution of the ratio between water absorption and water loss. This feature is of most importance when conditions are most extreme, but some idea of the efficiency of the mechanism can be gained from the fact that experiments with *Elymus* have shown that even under slight air movement the rolled leaves transpire only about a tenth of the water lost by the leaves when flat.

The only plants of these early phases which have not such automatic transpiration checks are those of the drift line on the dune face. These species are able to survive during periods of shortage by storing up copious internal water reserves, the presence of which renders the leaves succulent. The two most frequent are the sea rocket (*Cakile maritima*) and the prickly saltwort (*Salsola kali*). Both are very tolerant of sea water.

By the activity of the pioneer species, three main changes result. The embryo dunes rise in height, extend laterally and the hummocks coalesce to form a definite ridge, which may attain to heights of from sixty to one hundred feet in Great Britain. The decaying leaves, rhizomes and roots add organic material to the sand mass. Thus the dune becomes not only less mobile but also its capacity to retain the water that either falls upon its surface or condenses within is continually being augmented. So the extreme conditions become ameliorated and sooner or later, on advancing shores, the establishment of new dune ridges seawards of those already formed gives some protection both from sand removal and from rapid accretion.

The less specialized conditions which thus ensue are marked by the advent of other perennial species only slightly less specialized than the grasses. Of these the most characteristic are the sand sedge (*Carex arenaria*), the convolvulus (*Convolvulus soldanella*), sea spurge (*Euphorbia paralias*), sea holly (*Eryngium maritimum*) and rest harrow (*Ononis arvensis*). The sand sedge is remarkable for the rapidity of its growth and the extent of its rhizomes. From the parent plant the rhizomes radiate out like the spokes of a gigantic wheel and grow horizontally a few inches below the surface of the sand, sending up tufts of leaves at intervals of about four to six inches throughout their length. With the passage of time some of these tufts form the centres of origin of further radiating rhizomes, thus in a few years the sand is occupied by a sort of network bearing tussocks that constitute an efficient wind-break so that this species is an important stabilizer. The sea spurge and sea holly, not being rhizomatous species, have little capacity for lateral growth and so are more susceptible to sand removal, but they both exhibit rapid response, by new growth, to burial. In common with the other dune perennials, they meet the low water supply by means of a deeply penetrating and extensive root system (in the sea holly this may penetrate 2·7 m.); also they both possess leaves with a thick protective cuticle.

Up to this stage of dune development, a considerable area of bare sand is still obvious between the tufted growths. This implies great vulnerability to high winds and consequent risk of rapid erosion or accretion, thus precluding the development of species incapable of rapid growth. However, with the passage of usually about half a century, conditions have become sufficiently stabilized and the rate of accretion sufficiently diminished to permit the growth of dune annuals. These dune annuals are all characterized by germinating in the autumn, and passing through their life-history during the winter months, flowering in the spring and perishing with the surface drought of summer. They evade the adverse period in the seed state. The capacity of the dune annual to grow during the colder months of the year is enhanced by the warmth of the surface sand in sunshine. This brings about a rise in temperature of the air just above the sand. As a consequence, the leaves of these annuals are sufficiently warm to carry on active photosynthesis when this would be quite impossible for plants on other soils with a more normal capacity for heat conduction. Readings taken on the Norfolk dunes in April indicate that the temperature immediately surrounding the dune annuals may frequently be 10°–15° C. higher than the air generally.

All these dune annuals afford a striking contrast to the dune perennial by reason of their shallow roots, which only penetrate to an average depth of about four centimetres. They are enabled to flourish partly because of the frequent rains and high average humidity of the winter months, but even more because by the time of their arrival the pioneer species have added to the surface sand sufficient organic matter to augment appreciably the water-retaining capacity. Moreover, all these dune annuals are rosette species with foliage close to the ground, thus occupying the most humid layers of the air and a level least exposed to wind action.

It has been possible to obtain data as to the water loss by various species when in sand of a normal water content. Such data show that a plant of *Cerastium semidecandrum* may, on a sunny day, lose water at the rate of more than two grams per 100 sq. cm. of surface per hour. If we allow for the normal volume of soil exploited and the average water content, this rate of loss

involves complete removable of the available water supply within about a day. Since this species will survive a period of more than a week without rain, it is evident that it must depend on internal dew formation and upon the movement of water from beyond the immediate vicinity of the root system. The maintenance of such a flow requires some motive force, but this is supplied by the osmotic suction of the roots, which in various dune plants has been found to range from 9 to 20 atmospheres, or a force of from about 130 lb. to 290 lb. per sq. inch. Much higher osmotic pressures equivalent to 630 lb. to the sq. inch have been observed in dune plants of Algeria and California.

By their carpeting of the dune surface during the season of frequent high winds, the annuals materially diminish the risk of surface erosion, and they in turn add further to the humus in the soil. Their protective action, which ceases when they shrivel in summer, is augmented by certain mosses, of which *Tortula ruraliformis* is the most important, which endure periods of severe drought quite unharmed.

The prevalence of lichens also on the more advanced stages of stabilized dunes has given rise to the name of 'grey dune' in contrast to the younger 'yellow dune'. The vegetation carpet is quite efficient so long as unbreached by the tracks of man or the activities of the ubiquitous rabbit. The latter is often the source of exposure that permits wind entry and erosion, leading to a so-called 'blow-out', that either results in complete removal or initiates a 'secondary succession'.

A striking feature of earlier dune phases is the frequency of comminuted shell fragments among the sand grains. The proportion of calcium carbonate thus furnished varies greatly from one dune system to another. Some in Dorset contain practically none, and heather appears quite early in the dune succession, whilst other dunes contain a high proportion (up to 17 per cent at Bundoran in Ireland). In Portuguese dune samples from Comporta I found up to 27 per cent $CaCO_3$ in the young dunes and 0·2–0·4 per cent in the leached sands of the old. According to J. A. Van Steijn, the dunes of Holland show a similar range to those of Britain; he gives 0–18 per cent as the range of lime content. Where the calcium content is high, for example Tenby dunes, there are usually a number of calcicole species.

Before passing to the final stages of dune development, we may pause to consider a feature that will in most dune systems have already appeared. We shall note that dunes tend to develop as ridges parallel to one another. This usually intermittent formation is partly due to the presence of the main dune ridge, which by upward deflection of the on-shore wind produces a relatively calm condition at the ground-level immediately in front, so that embryo dunes starting here would exhibit little accretion. Still more, perhaps, it is due to the fact that the sloping sand in front of the ridge has the effect of pushing the main drift line farther out, and it is usually in relation to the buried drift that the new dunes begin to form. Thus the marram grass seedlings which arise along the drift line exhibit rapid growth and rapid accretion, and so form a young dune ridge separated from the pre-existing one by an interval. The parallel ridges often rest on a relatively impermeable substratum, and the water, of which the dune ridges are the catchment area, drains into the intervening hollows and sometimes forms what are known as 'dune slacks'. They naturally exhibit a marsh and aquatic vegetation which is beyond the scope of our present treatment, but there are a few special features to which attention must be directed. These slacks are the especial home of the creeping willow (*Salix repens*), which by its mode of growth and extensive root system (it will form roots more than 25 ft. in length) is able to spread into the dunes proper and can even grow successfully in mobile sand, but its apparent role as a pioneer is probably illusory, despite all statements to the contrary.

Into these slacks the drainage water from the dune ridges brings the nutrients, particularly the calcium salts leached from above, and to this fact we must, I think, attribute the presence of species that we more particularly associate with dry chalky soil. Such plants as *Chlora perfoliata*, *Linum catharticum*, *Gentiana campestris*, even *Carlina vulgaris* and the lady's tresses (*Spiranthes autumnalis*) are to be found growing even in free water. In such a 'slack' the soil contained 3·0–3·7 per cent calcium carbonate and the reaction was *p*H 7·5. The dune ridges on either side of the 'slack' contained about 0·3 per cent of carbonates and were appreciably acid (*p*H 6·8).

The dune slacks are the especial home of the bog pimpernel (*Anagallis tenella*) and the brookweed (*Samolus valerandi*). Here too in the southwest grows the giant spiked rush (*Juncus acutus*), whilst in similar situations in the Southport dunes occurs a remarkable habitat form of the grass of Parnassus (*Parnassia palustris* f. *condensata*) and also a sand form of the beautiful *Pyrola rotundifolia*. There are also certain liverworts which are peculiar to this situation, notably the rare *Petalophyllum Ralfsii*, which exhibits perennation by means of tubers. The shallower slacks often become dry during the summer months and here occur remarkable depauperate forms of many species.

Throughout the dune development, certain continuous changes have been going on apart from the diminishing mobility and increasing water-retaining capacity to which I have especially directed attention. These are the progressive leaching out of the soil carbonates and the augmentation of the acid products of organic decay, and so it is that we find that the prevailing alkaline condition of the young dune passes gradually into an acid state of the old. In the regions of higher rainfall, peat accumulation leads to the development of heather moor as on the old dunes of the Culbin Sands on the Moray Firth.

The progressive changes in the character of the dune soil with the passage of time are shown by the two series of data summarized below. These show the increasing acidity (diminishing *p*H value), increasing organic content, and decreasing content of calcium carbonate, in two dune systems. One (Blakeney) with an initially low carbonate content, and the other (Southport) in which the initial carbonate content is comparatively high.

Approximate age of dunes in years	$CaCO_3$ %	Organic content %	Reaction
Southport Dune System			
2	6·3	0·53	8·2
6	4·15	0·33	8·2
14	3·17	0·68	8·15
25–55	2·6	0·74	7·8
100	1·14	4·0	7·2
200–280	0·28	5·9	6·4
Blakeney Point Dune System			
5	0·42	0·36	7·2
80	0·34	0·5	7·0
160	0·03	0·86	6·9
235	0·01	1·15	6·4
340	0·01	2·7	6·2

Whereas the young yellow dunes only possess a flora of about ten species, the later yellow dunes can support between fifty and sixty different kinds of flowering plants, and the comparatively stable grey dunes have a flora of more than a hundred, exclusive of those confined to the 'slacks'.

The specialization imposed by the physical attributes of the habitat itself have been permanently modified; but the final occupants may themselves create specialized physical conditions which once more restrict the supportive capacity of the habitat.

Landscape at the Royal Academy

IN considering pictures from the point of view of science, one is glad to subscribe to what appears to be Ruskin's central doctrine, which may be put thus: a creative artist in portraying natural subjects, whether figure or landscape, should base his work, except in so far as it is meant to be symbolic, on a scientific realism expressing the love of Nature, and should carefully restrict the selection of particular effects to the suppression of others where this is rendered necessary by the limitations of the medium.

There can be no question but that both scientific realism and the love of Nature are apparent in the pure landscape work which has figured so prominently in British art since the time of Constable, and that the annual exhibitions of the Royal Academy reflect this tradition. The 1938 exhibition has the usual large proportion of landscapes amid figures, portraits, historical scenes and coronation pageantry, and in this short notice attention may be directed to a few of the landscape canvases, leaving out of account the quite strong representation in water-colour.

Mr. Sydney Lee's "Lulworth Cove" (274) well suggests location in the midst of a stretch of the Dorset coast-line, as high, rugged and fierce as any in England. The rock-contortions about the cove should please geologists, but the general alignment of the cove in relation to the open sea will certainly force attention on the laws of perspective.

Another pleasing Dorset scene is that in a small picture by Major C. E. Phillips, secretary of the Royal Institution, entitled "On the Purbeck Hills" (76). The general conformation of the land, as well as the line of stone walls in the background, would place this scene, not in the range of chalk downs that sweep round by Corfe Castle, but in the limestone ridge the upturned edge of which forms the splendid high coast between Swanage Bay and St. Aldhelm's Head.

In "Bibury Bridge" (26), Miss Kathleen M. Pearson presents a typical Cotswold scene: the delightful oolite stone, ever dominant, never out of harmony with other elements, the backing of stately elms gloriously grouped, and the foreground touch of animation given to the precincts of the village by two lads with a dog. The "Sutherland" (314) of Mr. Borlase Smart shows an inlet of the sea overlooked by mountains; but the whole power of the picture to the present writer lies in its suggestion of the wild tract of the Northern Highlands that lies behind the scene depicted. The grand simplicity of the title hints, indeed, that this is precisely the reaction the artist intends. "On the Moors, Skye" (760), by Mr. Arthur T. Nowell, is a skilful rendering of the beautiful lighting effects so typical of showery weather in the wild hills of the Western Highlands.

The background of Mr. Walter Goodin's "The River, Beverley" (429) is occupied by intensely black thunder-cloud, and the foreground, beneath brighter sky, by a great poplar obviously waving and rustling in the wind against which the storm is coming up—a most realistic example of landscape meteorology. Dazzling lightning, with the branching structure revealed in photographs, leaps across the mountains in Mr. Frederick C. Tilney's "Nothing Matters to a Machine" (571), in which a motor-car is seen speeding through a rugged defile. If it be objected that the landscape artist should paint what he sees of lightning, not what he knows about it, one can retort that some artists have extraordinary sight for lightning structure, as evidenced by Turner, in whose time photography was in its infancy.

There are various snow scenes from different parts, but that exhibited in J. McIntosh Patrick's "An Exmoor Farm" (313) is peculiarly charming by reason of the delicate contrast of the expanse of misty glaucous sea, very true to type, seen away in the distance. "The Bow in the Clouds" (192) of Victor Weingott, wherein a rainbow with secondary arc appears over a number of well-portrayed human figures, may be mentioned because it is very unusual in pictures to find the luminosity of the sky so accurately graded as between the inside of the primary, and outside of the secondary, bow.

The convolutions, rifts and gulfs in the white surface of a magnificent chain of cumulo-nimbus cloud are rendered with some success in Mr. James Bateman's "Farm Yard" (227), but it may be questioned whether the lower mass of cloud to the right of the picture is in the correct plane. Lawn and trees in a midsummer setting of deep blue sky and small radiant cumulus clouds are given in Mr. Algernon Newton's "Wimpole Hall, Cambridgeshire" (407), and it is interesting to note the same type of study by the same artist on foreign soil in "The Villa Starhemberg, Bad-Ischl, Austria" (144). Lawn and trees are in brilliant sunlight in front of the villa, but stormy-looking clouds are beginning to rear up over the Alps behind, and very intense shadow is being cast by the mountain shoulder on the left—an impressive illustration, to be sure, of Ruskin's "mountain gloom". The fault of this telling picture is the uniform dull brown colour in which the foliage of the trees in front and the mountain slopes behind are painted.

Landscape art makes a unique contribution, not so well appreciated as it ought to be, to meteorological science, in fixing just those subtle scenic aspects of atmosphere and weather, in short, those imponderable elements in climate, that not only produce profound psychological reactions but also inevitably leave their stamp on the development of art and literature.

L. C. W. BONACINA.

Obituary Notices

Mr. T. H. D. La Touche

WITH the death on March 30 at the age of eighty-two years of Thomas Henry Digges La Touche, the Geological Survey of India has lost its oldest member. Educated at Shrewsbury and St. John's College, Cambridge, that breeding-place of geologists, he was appointed to the Geological Survey of India in 1881, promoted superintendent in 1894 and acted as director in 1906 and 1909, retiring in 1910.

During his service of almost thirty years, La Touche acquired an exceptionally wide acquaintance with all aspects of Indian geological problems, scientific and economic. His work extended from Baluchistan in the west to the Burma-Chinese frontier in the east, and included investigations of the coal-measures of Assam, Kashmir and the Northern Shan States; the sapphires of Kashmir; oil in Baluchistan; the great silver-lead-zinc deposits of Bawdwin in conjunction with Dr. Coggin Brown; and the Lonar Lake with Dr. Christie. He also investigated the geology of western Rajputana, and his account includes a detailed petrological description of the igneous rocks of that region.

La Touche's greatest work, and the one which he himself looked back upon with legitimate pride, was the survey of the Northern Shan States of Burma. This was undertaken during the later years of his service, and from time to time he had the assistance of other members of the Department. The results, embodied in *Memoirs, Geological Survey of India*, vol. 39, part 2, with descriptions of the fossils by various specialists in the *Palaeontologia Indica*, opened up an entirely new chapter in the geological history of Burma and embodied "many valuable discoveries bearing on the question of the extension of Asian Zoo-geographical provinces during the Palaeozoic era"

In addition to his official publications, La Touche found time to edit for the Asiatic Society of Bengal, of which he was president, the journals of Major James Rennell, the first Surveyor General. He was also a superb amateur photographer, and his ingenious adaptation of the Walker balance to the rapid determination of the specific gravity of rock specimens is well known to all his colleagues.

After his retirement, La Touche's services were not lost to India. In 1914 he published "A Bibliography of Indian Geology and Physical Geography with an Annotated Index of Minerals of Economic

Value". This was followed by the index to genera and species described in the *Palaeontologia Indica*; an index to the *Records*; and finally, the last proof reaching him just before his death, the index to the *Memoirs*. This series of publications is of inestimable value to all interested in Indian geology, and the Survey can congratulate itself on being the best documented service in existence. In addition, he prepared for the Geological Society a list of literature added to its library during the War period.

La Touche's interest in geology was very wide, and his knowledge was always at the disposal of any inquirer. His work is characterized by a minute attention to detail, a scrupulous accuracy of observation, and a strict regard for truth. He received no recognition from official nor from non-official bodies, but he has left behind him a record of a lifetime's work which can rarely have been equalled, and a lasting monument to his industry, the more surprising as he suffered throughout his career from greatly impaired sight.

La Touche married Miss Handy, an Irish lady of great charm, and had five children, two boys and three girls. One son was killed in the War while the other carries on the family tradition of service in the East as a member of the Burma Forest Service. To his widow and the surviving members of the family the sympathy of all his old colleagues is respectfully tendered.

G. H. TIPPER.

Prof. John Taylor

BY the death of Prof. John Taylor on April 11, Irish engineering has lost one of its best known figures. Born near Gask, Perthshire, in 1865, he received his early engineering training in Glasgow at the Cowlairs Locomotive Works of the late North British Railway. In 1888 he won a Whitworth exhibition from the Anderson Technical College, Glasgow, and a Royal scholarship tenable at the Royal College of Science for Ireland, and proceeded to Dublin. He took the associateship of that College in 1891, after which he received a junior appointment on the staff and in 1902 became lecturer in engineering. In the University of Dublin, in 1903, he gained the large gold medal and senior moderatorship in experimental science. In 1929, a few years after the Royal College of Science for Ireland had been taken over by University College, Dublin, he was appointed professor of mechanical engineering in the National University of Ireland. About two years ago he received the degree of D.Sc. (*honoris causa*) of the National University.

Prof. Taylor did much work on the causes behind the failure of materials, and his technical advice was frequently sought by Irish public bodies. He conducted tests necessary for the planning of the dam in connexion with the proposed hydro-electric undertaking of the Liffey scheme at Poulaphouca, and carried out experiments with fish passes for the Shannon hydro-electric scheme. In recent years he devoted a considerable amount of his time to an investigation into the efficiency of turf burning appliances, a study which he undertook at the request of the Industrial Research Council of Eire, of which he was a member. His work in this connexion has already resulted in efficient domestic cooking ranges, suitable for the Irish turf consumer, being placed on the market.

In his teaching work, Prof. Taylor was noted for his thoroughness and enthusiasm. During his long career as a teacher a very large number of students passed through his hands, by all of whom he will be remembered as a man of the highest character with the most conscientious devotion to duty.

Mr. F. J. Gould

MR. F. J. GOULD, who died on April 6, was one of the most devoted and persistent workers in the cause of humanism and world peace. He was born in 1855 and kept up his activities in writing and speaking for his faith to within a few weeks of his death. He himself published annually an account of what he had done in the way of writing, editing and above all giving moral lessons to the young, and this amazing record moved large numbers of persons to subscribe to a sustentation fund which had become necessary for him when his uneasy relations with the London School Board came to an end in his early years. He had been an assistant master in East End elementary schools, and the kind of religious teaching which was required of teachers in those days was much more hotly debated than it is now in less dogmatic days. But Gould's ideal was never in doubt and never changed. He advocated from first to last the teaching of a sympathetic outline of the chief faiths of the world and the education of the young mainly by moral and historical lessons based on the admirable features of the past.

Gould had in early years been deeply influenced by the Englishmen, who, like Frederic Harrison, owed their spiritual direction to Auguste Comte. To this he added a strong socialist leaning and a faithful association for more than fifty years with those who defended the claims of free thought in the pages of the *Literary Guide* and elsewhere. His apostolic journeys took him over the greater part of the United States as well as India, while for many years he laboured as secretary for the International Congress of Moral Education. He acted in this capacity in London, The Hague, Geneva, Rome, Paris and Cracow. Before the Hitler régime he had been co-operating with liberal-minded Germans on a plan for an improved and more international method of teaching history. This perhaps was his deepest and most abiding motive.

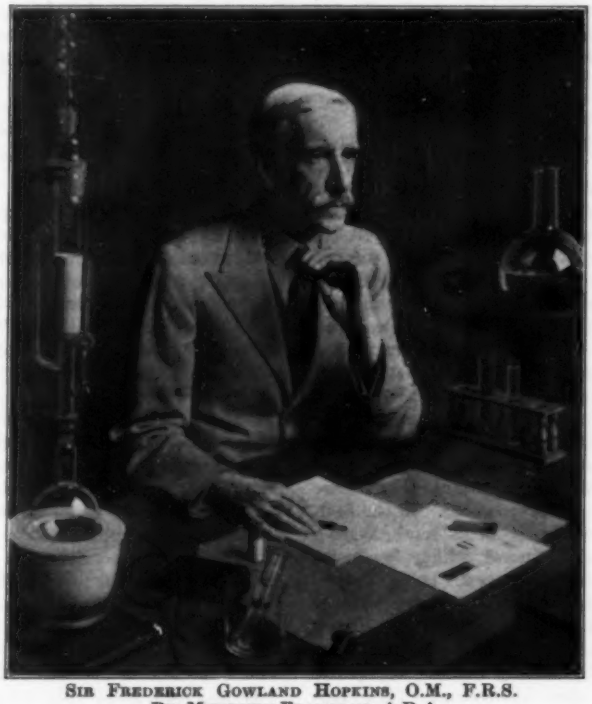
Gould's mind was a rare compound of peaceful and loving appreciation of men and opinions of every type, combined with an unbending and untiring tenacity in promoting the type of thought to which as a young man of just over twenty he had given his allegiance. It may be safely predicted that one day—and not very far distant—his name and work will be more loudly acclaimed and recognized than they have been in the first days following his demise.

F. S. MARVIN.

News and Views

Scientific Associations of the Royal Academy

AMONG the portraits of men of science and others known in scientific circles in this year's Royal Academy Exhibition, that of Sir Frederick Gowland Hopkins (196), by Meredith Frampton, a reproduction of which appears on this page, has led to considerable discussion as to extent to which a portrait should dominate its background. Other portraits to which reference may be made in these columns are: Sir David Milne-Watson, Bt., governor of the Gas Light and Coke Company (166), by Harold Knight; Sir Joseph Barcroft (263), by R. G. Eves; Lord Wakefield (371), by I. M. Cohen; Sir Frederick Moore (600), by Dermod O'Brien; and Havelock Ellis (1094), by Robin Guthrie. There is a sculptured head of Sir Michael Sadler (1571), by Loris Rey; and a head of Kelvin (1564), by Norman Tyrrell. Among the medals are that of the Institute of Metals (1471), by Harold Stabler; and the Hele Shaw Medal of the Institution of Mechanical Engineers (1485), by H. Paget. The architectural drawings include the National Institute for Medical Research at Mill Hill (1260), by Maxwell Ayrton; Beaumont Street extension of the Ashmolean Museum, Oxford (1277), by Stanley Hall and Easton and Robertson; the completed scheme of the house of the British Medical Association (1317), by Douglas and J. D. Wood; and the Palaces of Engineering (1360) and Industry (1366) of the Empire Exhibition, Scotland, 1938, by Thomas S. Tait.



SIR FREDERICK GOWLAND HOPKINS, O.M., F.R.S.
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Dr. W. F. K. Wynne-Jones

DR. W. F. K. WYNNE-JONES, whose election to the chair of chemistry in University College, Dundee, in succession to Prof. A. McKenzie is announced on p. 843, was educated at Monkton Combe School, Bath, whence he proceeded to the University College of Wales, Aberystwyth, and to Balliol College, Oxford. Later, as research assistant to Prof. J. W. McBain at the University of Bristol, he carried out experimental work on the Gibbs adsorption equation. In 1927–28, during the tenure of a Rockefeller fellowship, Dr. Wynne-Jones undertook a research on the problem of acids and bases under the direction of Prof. J. N. Brønsted in the University of Copenhagen. In 1933, he was awarded a Leverhulme fellowship which he held at Princeton University; where, in the laboratory of Prof. H. S. Taylor, he worked on the extent of the electrolytic dissociation of heavy water and the comparative rates of ionization of hydrogen and deuterium. In 1935 he published, in collaboration with Prof. H. Eyring, an important paper on the absolute rate of reactions in condensed phases. His recent work has furnished new information on the mechanism of ionic reactions. Since 1928, Dr. Wynne-Jones has held a lectureship in physical chemistry at the University of Reading.

Coal and Smokeless Fuel

THE Coal Measures of Great Britain, for all the depression in the coal industry, are still a great national asset. The article on "Oil from Coal" on p. 812 of this issue brings up once again the question of their proper utilization. It is common knowledge that it is technically possible to produce motor-spirit from coal: the difficulty is to find a reasonably satisfactory method. It appears, however, that we are now reaching a stage when it is legitimate to regard our seams of coal in the light of a series of oil-bearing deposits, since 'crudeable' products can now readily be produced from them. If the estimates of production costs given by Mr. Strevens and Mr. Cross are correct, and the coal-oil distillation process is the cheapest available, then, on the basis of this process, the Coal Measures of Great Britain are comparable with good medium-grade oil sands or shales.

The economically workable oil deposits of the world yield crude petroleums giving from 20 to 70 per cent of motor-spirit; the crude distillates produced from British coals by coal-oil distillation give 35–45 per cent or more; thus they fall in the middle of the range, on a par, for example, with Southern California oil stock. We should also recollect two further points. First, the hazards of extracting coal from the coal measures are, in general, considerably less than those of extracting petroleum from oil deposits. These latter hazards may be visualized by recalling that nearly a third of the million or so oil wells drilled in the U.S.A. are stated to be dead or abandoned. Secondly, the world's total reserves of motor-spirit to be extracted from coal are considerably larger than those to be extracted from petroleum.

THERE is another aspect of the question. The coal-oil distillation process yields a considerable amount of high-grade smokeless fuel. Thus its development might serve a triple function. It might in the first place (like any other satisfactory process of obtaining motor-spirit from coal) render Great Britain less dependent on external supplies of motor-spirit. In the second place, at any rate so long as tax discrimination in favour of home-produced motor-spirit is continued, it opens up the possibility of establishing an export trade in cheap smokeless fuel, thus helping materially to relieve unemployment and economic distress in the coal industry. In the third place, like any other process yielding cheap smokeless fuel, it holds out a hope of ridding Britain of much of the smoke which is not only productive of so much waste and material damage, but also so destructive both of health and of amenity. It is clear that we are entering on a new phase as regards coal. In the first, pre-industrial stage, coal was little more than a curiosity—a combustible mineral which here and there was used in preference to wood. In the second place, coal became the mainspring of industry, but was regarded simply as a fuel. In the third phase, now dawning, we must accustom ourselves to think of coal as a raw material generally demanding special treatments for its proper utilization. The new concern for health and social welfare is demanding that methods for preventing smoke shall be adopted, even if at some economic sacrifice. Coal-owners and public alike must learn to regard coal as a store of riches which it is for science and technology to unlock and make available.

Bureau of Animal Population

THE modest report of the Bureau for 1936–37 contains much of practical as well as of scientific interest, and this is vouched for by the contributions made towards its upkeep by the Medical Research Council, the Forestry Commission, the Agricultural Research Council, Imperial Chemical Industries Ltd., the Partridge Research Fund, and Hudson's Bay Company Ltd. At the same time, these varied patronages suggest something of the extent of interests served by Mr. Elton and his colleagues. The research on vole populations in itself touches upon many interests: fluctuations in numbers of voles are of immediate concern to the farmer and forester, and to the ecologist they present problems still awaiting solution; the discovery of a disease closely resembling tuberculosis in a large proportion (22 per cent) of voles trapped in areas ranging from the north-east of Scotland to Buckinghamshire, may give a clue to the high death-rate which closes a vole plague, and may have some relationship with human and bovine tuberculosis. These and other vole matters are engaging the attention of a strong team of scientific workers. Research on partridge fluctuations continues, and from 1938 for a period of three years at least, data are to be collected and a much-needed analysis is to be made on the periodic fluctuations of rabbits and hares in Great Britain. It says something for the desirability of scientific investigation and propaganda, that in the report from the Select Committee of the House of Lords on Agriculture (Damage by Rabbits), running to some 270,000 words, less than a hundred were devoted to research.

APART from its British inquiries, the Bureau has given its help to investigations in North America on fluctuations in numbers of the snowshoe rabbit, an arctic wild-life inquiry, and on the evidence in the Hudson's Bay Company's archives of a ten-year cycle in fur-bearing animals. The only unsatisfactory feature of the report is concerned with finance. Although in this respect the position of the Bureau seems more assured than in former years, the fact that it is kept in being by grants drawn from fourteen different sources, suggests that the collecting of moneys must occupy an undesirably large proportion of the time and energy of the scientific worker responsible for its organization, and that the staff must be labouring under some uncertainty as to their future. Neither condition is conducive to the best scientific work, and we look forward to a day when the Bureau will become an integral part of a State-organized biological survey.

The Ebro and Zi-Ka-wei Observatories

IT has been from time to time a pleasure during the protracted civil war in Spain to receive the *Boletin del Observatorio del Ebro* and to realize that the famous Jesuit observatory was working away peacefully in Republican Spain. Father Rodés and his staff have been carrying on their heliophysical, meteorological and seismological work steadily with support from the Government—last year their grant was paid in full—the autonomous Government of Catalonia and the municipal councils of Villanova and Geltru, though they have been faced with severe difficulty in securing necessary scientific material and have been naturally unable to collect meteorological data from their observers scattered throughout Spain. Now comes the sad news, reported by the Burgos correspondent of *The Times* (April 25), that the tide of war has swept over them and that instruments have been dismantled and damaged during the hostilities, while the director, Father Rodés, has been taken to Barcelona. It is to be hoped that he will soon be released and enabled to return to his

observatory and to restart the many series of observations of international importance that have been thus forcibly interrupted. Nothing much has been reported about another famous Jesuit geophysical observatory, that at Zi-Ka-wei, close to Shanghai, with its astronomical sub-station at Zô-Sè, some forty miles away. They, too, have lain in a ravaged war zone, but their latest publication from Zô-Sè ("Perturbations générales par Jupiter et Saturne sur 40 petites planètes", par le P. E. de la Villemarqué, *S.J.*) received less than a week ago, suggests that the astronomers have been allowed to carry on unmolested.

Royal Institution

THE annual meeting of the Royal Institution was held on Monday, May 2. In the unavoidable absence of the president, the chair was taken by Sir Robert Robertson, treasurer and vice-president. The customary report of the Committee of Visitors and statement of accounts were presented at the meeting. It was stated that the vacancy in the professorship of natural philosophy caused by the death of Lord Rutherford has not yet been filled; Sir James Jeans has been re-elected professor of astronomy and Sir Frederick Keeble has succeeded Sir Edward Mellanby as Fullerian professor of physiology. An important addition has been made to the equipment of the lecture theatre by the installation of a talking cinematograph projector, which it is expected will be of increasing value as talking films and films with sound effects come more generally into use for lecture illustrations. Early last year, a fire at No. 19 Albemarle Street, which is partly occupied by the Institution, was fortunately discovered and extinguished before it had become extensive; the damaged books and other effects have now been restored, and the loss was fully covered by insurance. The treasurer's report showed that the legacy of the late Mr. Harry Brown, now completed, has resulted in an addition to the funds of the Institution of no less than £30,987 3*s*. 2*d*. Important subsidies for the researches in progress include £500 per annum for a further period of three years from the Anglo-Iranian Oil Company, £500 per annum for five years from the Leverhulme Trustees, and a Coronation gift of £2,000 from Sir Robert Mond.

"MEMBERS are less familiar with, because they see less of, that important part of the Institution's activities, the research work which is carried on under Sir William Bragg's direction," say the Visitors in speaking generally of the Royal Institution's work. The wide range and great interest of the researches may be gathered from the report of the Davy Faraday Laboratory, printed as a supplement to the Visitors' report. Researches quoted include those on the X-ray structure analysis of nickel phthalocyanine and stilbene; on the dielectric polarization of long-chain ketones, and on the X-ray study of metals, beginning with the elastic properties of single crystals of sodium. The optical work on methane and CH_3D has been further developed, and a new type of absorption tube, using the Rowland grating, has been employed. It is recorded that the large X-ray generator has now been tested to its full capacity of 50 kilowatts; and a research programme in connexion with this generator, including high-dispersion measurements on metals, is spoken of. The following officers were elected at the meeting: *President*, Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips; *New Managers*, Sir Frederick Berryman, Dr. F. H. Carr, Prof. F. L. Hopwood, Mr. P. V. Hunter, Sir Richard Paget, Dr. A. O. Rankine, Dr. R. Seligman, Prof. G. P. Thomson; *New Visitors*, Dr. W. R. Bisschop, Mr. E. R. Bolton, Dr. W. A. Caspari, Prof. C. D. Ellis, Dr. W. Hall, Prof. J. T. MacGregor-Morris, Dr. L. C. Martin, Mr. C. Rowntree.

Exhibition of Buddhist Paintings

IN the exhibition of Buddhist paintings now open in the Edward VII Gallery of the British Museum (Bloomsbury) the examples shown have been selected with the view of demonstrating the different types of religious painting which have been produced by Buddhist thought and belief in the varying environment of, so far as possible, the whole of mid- and farther Asia. It covers the manifestations of Buddhist religious art in China, Japan, Korea, Siam, Tibet and Turkestan. No equally comprehensive exhibition has ever been held previously in England. The opportunity for such a display has arisen through the acquisition of several important paintings from Korea and Siam with the Eumorfopoulos collection, which also includes the first two examples to reach the Museum of the wall paintings recovered from Turfan by A. von Le Coq. Tibetan painting is represented by a selection from a series of the sixteen Arhats and the four Lokapalas from a temple at Shigatse, deposited on loan by Mr. J. C. French. They are much earlier than those usually seen in Europe. Of great interest to the student of early Far Eastern painting are the Japanese reproductions in collotype of the famous eighth-century wall paintings from the Buddhist shrine at Hôryûji. The five shown are each twelve feet high. These paintings are especially remarkable, owing to the fact that they are examples of the fresco art of the T'ang period of China, which has vanished from her own soil. In an official account of the exhibits, it is justly pointed out that the key to the exhibition is the full selection from the paintings recovered by Sir Aurel Stein from the sealed chamber of the Caves of the Thousand Buddhas, near Tun-huang in Sinkiang. Some of the woodcuts from the same source are the earliest known in the world. To round off the demonstration, reproductions of the Ajanta frescoes are shown as an indication of the different kind of painting produced in the original home of Buddhism. The common bond in the religion which all these schools of painting served, indicates the extent to which these parts of Asia formed a cultural unity; while the examples themselves illustrate the richness and variety of religious painting in the East.

Special Libraries and Information Bureaux

THE Association of Special Libraries and Information Bureaux held a luncheon on April 27 at which a company of more than eighty was present. After saying that he hoped the luncheon would become an annual event, the president, Sir Harry Lindsay, director of the Imperial Institute, spoke of the three stages of science: first scholasticism, dominated by the great men of science, then the period of the authoritative text-books, now the era of the individual specialist. The results of modern scholarship are scattered in innumerable technical journals and, in order to keep abreast, search must be made over a very wide field. The same is no less true of other spheres of knowledge. ASLIB was therefore formed to act as a guide to specialist sources of information. The next speaker, Sir Clement Hindley, chairman of the Racecourse Betting Control Board, mentioned his connexion, as vice-president, with the Institution of Civil Engineers. The Institution's abstracting service, started so long ago as 1877, he said, has recently been considerably expanded in collaboration with other institutions representing different branches of engineering. This expansion should interest all who, as members of ASLIB, are eager to facilitate the dissemination of knowledge. Sir Ian MacAlister, secretary of the Royal Institute of British Architects, stated that in the nineteenth century people created every sort of institution and machine, political, social and mechanical. In the post-War years of disillusionment, we realized that machines are of no use unless they work, museums are a costly extravagance unless their treasures can be made intelligible, and libraries are mere hoards of books if inaccessible to those who need them. A new desire to make the instruments of civilization work is now awake, and ASLIB is a valuable and essential part of this great movement.

Prehistoric and Primitive Iron Smelting

IN a paper bearing the above title read to the Newcomen Society on April 20, Mr. E. W. Hulme reviewed the history of the use and manufacture of iron through a period of about 3,000 years, from the date of the earliest known examples of beads made of meteoric iron down to about the first millenium. The first example of terrestrial man-made iron, he said, was the iron dagger found by Woolley at Tell Asmar in Mesopotamia. Unlike objects made from meteoric iron, this is free from nickel. Besides the objects found in tombs and the fragmentary records such as the diplomatic correspondence recorded in the clay tablets of Egypt and Asia Minor, Mr. Hulme dealt with the sites and processes associated with early iron making. These included the Egyptian by-product iron process by which very small amounts of iron were obtained from sands containing magnetite and gold; the Wootz steel-industry of southern Central India, the Chalybian steel process described by the Pseudo-Aristotle (fourth century B.C.), the iron industry of Persia and the Gerar forges of Southern Palestine. The claims of Persia to rank amongst the earliest makers of iron have been overlooked, but if they can be substantiated the migration of the industry to China, India, Syria and Palestine becomes explicable. When referring to the Gerar forges of Palestine described by Sir Flinders Petrie, Mr. Hulme said that though his interpretation of the purposes of the furnaces differed from that of Sir Flinders, "for the recovery of these dateable sites and for the meticulous accuracy in the description of the large output of these forges, all metallurgists owe a warm debt of gratitude to the veteran explorer who has done so much to recreate for them the history of Egypt and the Near East".

Paris Television Transmitter

ACCORDING to a note in the *Wireless World* of April 21, a new television transmitter at the Eiffel Tower, Paris, was inaugurated on April 8 by the Minister of the French postal and telecommunications service. The transmitter, which has been in regular operation since September 1937 with reduced power, will shortly be broadcasting with its peak output of 30 kw., thus making it one of the most powerful television stations in the world. The aerial is supported by the Eiffel Tower and connected to the transmitter by a cable 380 metres long. Two new studios with the most up-to-date equipment are situated at distances of 2·5 and 5 kilometres from the transmitter, to which they are connected by co-axial cables. The vision modulation frequencies are impressed on a carrier frequency of 5·5 Mc./sec., the total band transmitted down the cable being from 3 to 8 Mc./sec. The transmitter is designed to operate on a frequency between 40 and 50 Mc./sec., at its continuous peak power output of 30 kw. The frequency is maintained constant within narrow limits by a quartz crystal oscillator, followed by two doubler stages, which raise the frequency to the final carrier value. Some further technical details of the transmitter are given in the article to which reference is made above.

X-Ray and Radium Protection

THE fifth revised report (January 1938) of the British X-Ray and Radium Protection Committee shows that the Committee is alive to the necessity of continually adjusting its recommendations to the expanse of its subject. The chief additional items in this report are to be found in Section v, dealing with the necessary electrical precautions in X-ray rooms, in Section viii (*C*), which deals with radium teletherapy, and in Section ix, where the incidental dangers in the use of electro-medical apparatus, especially apparatus activated from the mains circuit, are considered. This report contains a valuable appendix giving the equivalent thickness of lead and materials in use for general radiation protection; the data are supplied by the National Physical Laboratory. The services of the Laboratory are largely made use of by those in charge of radiological departments, both in a consultative capacity in planning, and for purposes of test when the assembly of apparatus is completed. Copies of the report are sent free on application to the Hon. Secretaries of the Committee, 32 Welbeck Street, W.1.

Pests of Ornamental Plants

THE attention of garden lovers and horticulturists is directed to Bulletin 97 of the Ministry of Agriculture and Fisheries, entitled "Pests of Ornamental Garden Plants" (1937). This publication deals with an aspect of horticulture seldom adequately treated in text-books on insect and other pests. The problem of controlling pests in gardens is, moreover, different from that of the commercial grower. The author of this work is Mr. G. Fox Wilson, entomologist to the Royal Horticultural Society, and he has provided authoritative and practical advice on the pests in question. General measures of control are discussed and the different pests are described under their respective headings, such as lawns, the annual border, rock garden, glass houses and so on. The work is well and fully illustrated, while the price of 3*s*. 6*d*. net is very reasonable for a Bulletin strongly bound and containing more than 100 pp. of letterpress. It can be obtained from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, or through any bookseller.

A Binocular Illusion

REFERRING to Prof. H. H. Dixon's letter in NATURE of April 30, Miss E. Armitage, Dadnor, Ross, Herefordshire, writes to suggest that the checkerboard appearances may be akin to that commonly observed when studying photographs of lunar phenomena, the 'walled plains' sometimes appearing as convexities and sometimes as concavities, according to which side the shadow appears to fall.

World's Congress of Faiths

A WEEK-END Congress of the World's Congress of Faiths (Continuation Movement), of which Sir Francis Younghusband is chairman, will be held at Regent House, Cambridge, on June 24–28, when the subject under discussion will be "The Renascence of Religion". Addresses will be delivered by representatives of the various religions, with discussions to follow. Among the speakers who have already promised to address the Congress are Sir Sarvepalli Radhakrishnan, Spalding professor of eastern religions in the University of Oxford, for whom Canon C. E. Raven, regius professor of divinity in the University of Cambridge, will take the chair, and Baron E. K. Palmstierna, formerly Swedish Minister to the Court of St. James, for whom the Master of the Temple, Canon H. Anson, will preside. Members of the Congress will be accommodated in St. John's College (men) and Newnham College (women). Particulars of membership and other arrangements may be obtained from the Secretary, World's Congress of Faiths, 36 Victoria Street, London, S.W.1.

Presentation of Kelvin Gold Medal

THE Kelvin Gold Medal for 1938 was presented to Sir Joseph Thomson, master of Trinity College, Cambridge, in recognition of the eminent services he has rendered to engineering science, by Lord Rayleigh, in the Great Hall of the Institution of Civil Engineers on May 3. The executive committee of the memorial fund to Lord Kelvin, representative of nineteen British and American Institutions, decided that the balance of the Fund, after defraying the cost of a window unveiled in Westminster Abbey to the memory of Lord Kelvin in July 1913, should be applied to the establishment of a Kelvin Gold Medal to be awarded triennially as a mark of distinction in engineering work or investigation of the kinds with which Lord Kelvin was especially identified. The award of the first Kelvin Medal was delayed by reason of the War, and it was not until 1920 that the first award was made to the late Dr. W. C. Unwin (Great Britain). The following awards have since been made: Dr. Elihu Thompson (United States); Sir Charles Parsons (Great Britain); M. André Blondel (France); Marchese Marconi (Italy); Sir Ambrose Fleming (Great Britain).

Presentation of James Alfred Ewing Medal

MR. S. B. DONKIN, president of the Institution of Civil Engineers, presented the James Alfred Ewing Medal to Mr. Charles Samuel Franklin immediately before the delivery of the James Forrest Lecture by Sir Frank Smith. This Medal was founded in 1936 in memory of Sir Alfred Ewing, an honorary member of the Institution, and is awarded for specially meritorious contributions to the science of engineering in the field of research, on the recommendation of the presidents of the Royal Society and of the Institution of Civil Engineers. Mr. C. S. Franklin is well known for his inventions and developments in connexion with beam wireless. The rotating beam aerials installed experimentally at Poldhu in Cornwall were designed by him, whilst he was also responsible for the concentric feeder system for supplying energy to radio aerials and enabling extremely high-frequency currents to be transmitted along a line without loss. These feeders are used in the beam system and are essential to television transmission circuits.

Ninth International Ornithological Congress

THE ninth International Ornithological Congress, which will be attended by ornithologists from every part of the the world, will be held in Rouen on May 9–14. Later, the members of the Congress will proceed to Paris and the programme will terminate with a long excursion to the bird reserves in the Camargue. All questions concerning the preservation of birds will be dealt with at the meetings of the International Committee for Bird Preservation, which will be held immediately before the Congress. These meetings are confined to the official delegates of the national sections, which are operating in twenty-eight different countries, of the Committee. In connexion with the Congress an international exhibition of bird pictures is being held in Paris on May 14–29. British ornithological art will be represented by the works of Roland Green, G. E. Lodge, Peter Scott, Archibald Thorburn (lent by Messrs. W. F. Embleton) and A. W. Seaby (lent by Mr. A. W. Harvey Brown, Stevens and Brown Gallery).

Travelling Fellowships in Medicine

THE Medical Research Council invites applications for six Rockefeller Medical Fellowships for the academic year 1938–39. These are provided from a fund with which the Council has been entrusted by the Rockefeller Foundation of New York and are intended for British graduates who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. The stipend will ordinarily be at the rate of £360 per annum for a single Fellow, and of £480 per annum for a married Fellow. Travelling expenses and some other allowances will be paid in addition. The Council also invites applications for four Dorothy Temple Cross Research Fellowships in tuberculosis, which are awarded from a special endowment of which the Council is the trustee. The object of these fellowships, as defined in the trust deed, is to give special opportunities for study or research to suitably qualified British subjects of either sex "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". The stipend will ordinarily be at the rate of £360 per annum for a single Fellow, and of £480 per annum for a married Fellow, with an allowance for travelling and incidental expenses. Completed applications for fellowships of either type must be lodged with the Council not later than June 1. Further particulars and forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Announcements

THE Council of the Royal Society of Edinburgh has awarded the Neill Prize for the period 1935–37, to Prof. William J. Hamilton, St. Bartholomew's Hospital Medical College, for his contributions to the embryology of the ferret and other work published in the *Transactions* of the Society.

THE first of the two annual soirées of the Royal Society will be held on May 18.

THE Frankfort Senckenburg Society of Natural Science has awarded Prof. W. H. Hoffmann, director of the Finlay Institute of Havana, the Great Iron Medal of Honour, which is the highest distinction conferred by the Society, in recognition of his researches on tropical medicine.

IN NATURE of April 23 (p. 745), two record-breaking flights in gliders were announced. A new distance record was made on April 30 by Mr. Philip Wills, who flew from Heston to St. Austell in Cornwall, a distance of about 206 miles.

THE Challenger Society will be making further grants in aid of research during the current year. The general committee is prepared to consider applications for some grants in aid of research in marine biology, the work preferably to be carried out at one of the recognized laboratories. Applications, accompanied by details of the proposed research, should reach the Honorary Secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the middle of June.

FARMERS and all interested in agriculture in its practical, technical or educational aspects are cordially invited to visit the Rothamsted and Woburn Experimental Stations at any convenient time between the beginning of May and the end of October. Mr. H. V. Garner and Capt. E. H. Gregory will be in charge of the demonstrations, and there is ample material at either of the farms to occupy a full day. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

THE Royal Sanitary Institute is giving a further course of lectures and demonstrations on pasteurization for medical officers of health, sanitary inspectors and others interested on May 26 and 27. Further information may be obtained from the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1.

AN institute for the study of the causes and treatment of influenza has recently been established at Budapest.

THE Cuban Government has recently allotted a million dollars from its lottery funds for a campaign against tuberculosis. Clinics are to be established throughout the country for the examination of every citizen.

THE first French Congress of Good Bread will be held at Nice on May 14 and 15. Further information can be obtained from the General Secretary, M. Robert Septembre, 16 rue de l'Hotel des Postes, Nice.

THE International Red Cross Conference, which was to have met in Madrid this year, will be held in London on June 20–24. The opening and closing sessions will take place at St. James's Palace, and the other meetings at the British Medical Association House, Tavistock Square, where further information can be obtained.

THE third International Congress of Tropical Medicine, which was to have been held at Amsterdam, and the third International Malaria Congress, which was to have been held at Madrid in 1935, had both to be postponed, but a joint congress will be held at Amsterdam on September 24–October 1 under the presidency of Dr. G. Gryns. Further information can be obtained from the Secretary, Mauritskade 57, Amsterdam 0.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 836.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

AN ETHICAL DECLARATION FOR THE TIMES

IN the last few years several of the most enlightened communities of Europe have been dispersed, and the principles of justice and tolerance openly challenged. More than this, the conception of the objective truth which is the basis of science and of all human progress is being steadily undermined. European civilization has had profound failings, but we must either devote our energies to maintaining and developing what is good in it or accept a collapse into a barbarism of violence and intolerance. The greatest danger to-day lies in the complacent illusion — seen so often in history and now prevalent in the more fortunate countries — that civilized traditions are an inalienable legacy which can be enjoyed indefinitely by generations which are no longer ready to make sacrifices for them.

It is my belief that men in all countries who do not wish to betray the tradition they have inherited must now discard false modesty and announce clearly for what they stand. We do not deserve and we shall not long retain the fruits of a civilization to which we do not declare and prove our active loyalty. More than two thousand years ago the Hippocratic Oath was used to promote amongst practitioners of the art of medicine certain standards appropriate to their task. It is suggested that a Declaration such as that here reproduced should be offered to-day by cultural, educational, and technical institutions throughout the world to their members. The advance of intolerance and of the lie can only be reversed by awakening a militant loyalty to the principles of a world civilization, and this loyalty must be focused in special symbols and instruments.

DECLARATION

I AM the inheritor of the tradition of civilization which has proved more lasting than empires. Whenever I use the language or the products of science I unconsciously pay homage to the countless men for whom no sacrifice was too great in the struggle to develop the human mind and establish the truth. Toleration and freedom are the heart of this tradition; for individual thought and love of truth are the basis not only of science, but also of justice and of civilization.

I DECLARE my loyalty to this tradition, my belief in the freedom of the individual to develop his talents for the enrichment of the community, and my conviction that man's community is now the whole human race, within which each nation must play its characteristic part. The natural balance between personal freedom and the proper demands of society, which is the life and health of civilization, is to-day doubly threatened: in certain societies by the denial of freedom and in the democratic countries by the irresponsibility of individuals. In the face of this threat:

I PLEDGE myself to use every opportunity for action to uphold the great tradition of civilization, to protect all those who may suffer for its sake, and to pass it on to the coming generations. I recognize no loyalty greater than that to the task of preserving truth, toleration, and justice in the coming world order.

Though the Declaration is designed on the broadest human basis to appeal to all who understand what civilization means, it is appropriate that it should appear first in NATURE. Science is to-day the only non-partisan and universal authority, and its principles are at stake. If the Declaration is timely it may either serve as the stimulus to a special declaration of scientific faith by the scientific organizations in all countries, or spread from this background to wider circles.

The Declaration is copyright-free for reproduction or translation. Arrangements have been made to have it printed on cards, and copies may be had from For Intellectual Liberty, 23 Haymarket, London, S.W.1. at cost price.

L. L. WHYTE.

9 Stafford Mansions,
Stafford Place,
London, S.W.1.

Carriers of Foot-and-Mouth Disease

THE highly sporadic character of the occurrences of foot-and-mouth disease in Great Britain and its apparently repeated importation from the Continent have naturally caused much speculation about possible vectors, though the special difficulties of the case have prevented the direct demonstration of carriage.

Birds have often been incriminated, and Prof. A. C. Hardy, in his letter in NATURE of April 2, further suggests that insects may be carried far enough by air-currents even over the sea, to be considered also as possible carriers.

Neither birds nor insects can, however, be regarded as primary vectors, since neither group, so far as is known, can harbour the virus systemically, and viruses do not survive extra-cellularly for more than short periods. They can only be secondary carriers of the true agent of transmission. This might take the form of skin or hair particles or excreta of infected animals, adherent to the carrier, though the probability of birds, at any rate, becoming heavily contaminated in this way is not very great. It is not even necessary, in such circumstances, to assume the need for any vector, since the carrier material may equally well be disseminated by wind.

In this connexion it is perhaps worth while to direct attention to the work of L. A. Silber and his co-workers[1,2] and of Poppe and Busch[3] on the symbiosis of viruses and yeasts. The former have shown that smallpox and vaccinia viruses enter the yeast cells and form a close union with them, of an enduring character. The virus-yeast complex is passed intact from cell to cell during proliferation and the virulence may apparently be retained for an unlimited period. Variola virus has been propagated in this way through more than a hundred cell-generations. Poppe and Busch showed that the same is true of the foot-and-mouth virus, which also remains viable with the yeasts in serial sub-culture.

Yeasts of many kinds, *Torulopsis*, *Rhodotorula*, *Mycotorula*, *Candida*, *Sporobolomyces*, etc., abound in the soil and in the atmosphere, in which latter they sometimes outnumber the bacteria. In the air they seem to have a random distribution, considered as a population, but this is not the case for particular species, which are often to be found in local concentrations, strongly suggesting, as Trillat[4] claimed, that they can multiply in the air.

The possible importance of the aeroplankton yeasts as virus carriers is not, of course, limited to the case of foot-and-mouth disease, but it cannot be overlooked in any case. If it can be proved that yeasts carrying viruses of any type occur naturally in the free atmosphere, then the impossibility of precluding chance infection must be manifest and the importance of immunity in the subject is correspondingly enhanced.

The suggested role of yeasts as carriers is not limited to animal viruses. It may also provide the clue to the apparently vectorless outbreaks of tobacco necrosis recorded by Smith and Bald[5] and to Smith's observation of an air-filter contagion[6].

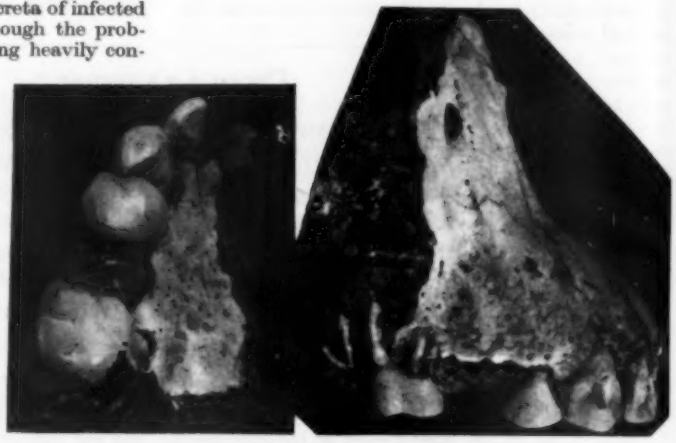
Department of Botany,
University College,
April 11. Cardiff.

R. C. MCLEAN.

[1] Silber and Wostruchowa, *Z. Bakt.*, Abt. 1, Orig., **122**, 314 (1934).
[2] Silber and Timekow, *Z. Bakt.*, Abt. 1, Orig., **133**, 242 (1935).
[3] Poppe and Busch, *Z. Bakt.*, Abt. 1, Orig., **136**, 385 (1936).
[4] Trillat, *Comptes rendus*, **170**, 1291 (1920).
[5] Smith and Bald, *Parasitology*, **27**, 1 (1935).
[6] Smith, NATURE, **139**, 370 (1937).

More Discoveries of *Australopithecus*

A FEW months ago I sent an account to NATURE[1] of the discoveries of a number of teeth of *Australopithecus*. The principal of those was a beautifully preserved third lower molar, but I also had found a new third upper molar and much of a first incisor.



(*a*) (*b*)

Australopithecus transvaalensis BROOM. (*a*) OCCLUSAL VIEW OF RIGHT UPPER TEETH AND PART OF PALATE; PART OF THE BACK OF THE CROWN OF THE FIRST MOLAR HAS BEEN DAMAGED BEFORE FOSSILIZATION. (*b*) SIDE VIEW OF RIGHT MAXILLA; NOTE THE REMARKABLY HUMAN-LIKE INCISOR AND CANINE. NATURAL SIZE.

Since then nothing more was found until two weeks ago, when a fairly well-preserved lower canine was discovered. This is so like a human canine that I hesitated to describe it in case it might prove to be human. The whole length of the tooth is about 32 mm., but as the tip of the crown is lost the exact length is uncertain. The crown cannot have been more than 10·5 mm. in height. The base of the crown measures 9 mm. by 6·3 mm. It is like the human lower canine, but the face of the crown is in *Australopithecus* directed more outwards than forwards. It bears no close resemblance to that of the chimpanzee either in size or shape.

Then last week I made a much more important discovery—a nearly complete right maxilla in good condition and with the second incisor, the canine, the first premolar and first molar in position. The premolar and the molar agree so closely with those of the type as to leave no doubt that the jaw is of the same species—*Australopithecus transvaalensis*.

This new specimen is of supreme importance as it shows that the canine is not much more enlarged than in man and that it is ground down to the same level as the first premolar and the second incisor; and further, that the second incisor, which is smaller than in man, is quite close up to the canine.

Much of the palate is preserved with part of the middle line, so that we now know the width, and the interesting point is revealed that the molar teeth do not form, as in the gorilla and chimpanzee, parallel series but rounded arches as in man.

The nostril measures about 23 mm. in width and the nose has probably been fairly similar to that in the chimpanzee. The infraorbital foramen is large and oval and lies 9 mm. from the orbital margin.

FACE OF *Australopithecus transvaalensis* BROOM, PARTLY RESTORED. ×¼.

The face agrees fairly closely with that of the chimpanzee, except that the reduction in size of the incisors and canines makes the anterior part of the snout much narrower and shorter. One might describe *Australopithecus* as a chimpanzee with human teeth. Whether it is a descendant from a chimpanzee-like ancestor or near the common ancestor of man and the chimpanzee need not at present be more fully discussed. Most will agree that if it had large canines it would be near to the chimpanzees, and if it had a large brain it would be near to man. Possibly it is near to the human ancestor, and it may be that man arose from a form like *Australopithecus*, by a mutation resulting in a large brain. Whether such a mutation was an accident or the result of the work of some spiritual force, opinions will differ.

R. BROOM.

Transvaal Museum,
Pretoria.
April 19.

[1] NATURE, **140**, 681 (Oct. 16, 1937).

Gilding of Copper among the Pre-Columbian Indians

I HAVE already given an account[1,2] of certain investigations regarding the metallurgical methods employed by the pre-Columbian Indians, especially their methods of procuring platinum in coherent form without fusing it, and I have demonstrated the metallurgical processes adopted by them in soldering by 'sweating', wire-drawing, the plating of gold with platinum, etc. Further investigations have now disclosed the fact that the Indians, at any rate those in the Esmeraldas district, gilded their copper objects in a fashion which appears to have been completely unknown hitherto, both to the ancient world and to us. It was previously supposed that such gilding must have been carried out in America with the help of mercury. Although it has been impossible to demonstrate traces of mercury in any of the gilded objects, no other explanation has been suggested.

After cleansing such objects to remove the products of corrosion and the remnants of gold still adhering to them, I have shown by chemical analysis that the copper contains varying quantities of gold in alloyed form—the largest amount on the surface and decreasing gradually towards the centre. Such unequal gold content might well be imagined to have arisen from the melted gold permeating the copper. Gilding must have been done by dipping the copper into a melted gold-copper eutectic (gold with about 20 per cent copper) the melting point of which is some 200° C. lower than that of copper; or possibly, the gold-copper alloy was applied to the copper and kept at red heat on charcoal by means of a blow-pipe. The alloy will then fuse and run over the copper without the use of flux being necessary, the reducing flame securing a glowing surface free of oxide. Investigations have shown that copper has a tendency to absorb the melted alloy in the same manner as melted tin permeates copper or a zinc rod absorbs mercury. The copper nucleus thus becomes a gold-copper alloy richest in gold at the surface, the amount of gold decreasing gradually. After the gilding process had thus been accomplished, the reddish tinge of the coating was improved by boiling out in pickle—in French, *mise en couleur*, in German, *Abochung*—a method with which, we know with certainty, the Indians were acquainted.

I have examined breastplates covered with gold, but only on one side, originating from Ecuador. These plates appear to have been beaten out from thicker plates which had already been gilded. This is quite feasible if care is taken that the gilding is not too thick. Gilding was used by the Esmeraldas Indians for other purposes than decoration. Of the thirty-five fish-hooks found, all were gilded, but not one single specimen of thirty-two sewing needles discovered. The gold which penetrates the copper fish-hooks makes the metal much harder, and hardness is the first consideration in a fish-hook.

Objects gilded in this manner are far more exposed to the attacks of corrosion than copper, and this probably has been a contributory factor to the difficulty which previous investigators have had in discovering the above facts.

Investigations have also shown that it is possible to silver copper in the same way.

A detailed statement will be made on the occasion of the Anthropological Congress which is to be held in Copenhagen this summer.

PAUL BERGSØE.

Copenhagen.
March 31.

[1] NATURE, **137**, 29 (Jan. 4, 1936).

[2] Bergsøe, Paul, "Metallurgy of Gold and Platinum among the Pre-Columbian Indians", *Ingeniørvidenskabelige Skrifter*, A., **44** (Copenhagen, 1937).

A Colorimetric Method for the Estimation of Nicotinic Acid in Foodstuffs

RECENT investigations[1,2,3,4] have shown that pellagra in human beings, black-tongue in dogs and pellagra-like symptoms in pigs, can be cured by the administration of nicotinic acid, and nicotinic acid is probably identical with, or a precursor of, the pellagra-preventive (P.-P.) factor. Hence the question of estimating the nicotinic acid content of foodstuffs is of immediate importance and interest.

A method has been developed based on the colour produced by the pyridine ring[5] when acted upon by cyanogen-bromide and aniline. A hot aqueous extract of the test foodstuff is freed from protein derivatives by lead acetate, the excess of lead being removed by sulphuric acid; the extract is brought to *p*H 10 and any colour present is removed by boiling with charcoal. The clear colourless extract is adjusted to *p*H 7·5 and made up to volume.

Aliquot portions of the extract and the standard nicotinic acid solution are each diluted with water to the same volume (20–30 ml.) in 100 ml. separating funnels; 4 ml. of freshly prepared aqueous cyanogen-bromide solution is then added to each and the mixture shaken and allowed to stand for half an hour. 4 ml. of a saturated aqueous aniline solution is then added and the mixture again shaken. The yellowish-green colour produced is then extracted three times with 10 ml., 5 ml. and 5 ml. portions of purified amyl alcohol[5] and the colours compared after standing for two hours.

The method is extremely sensitive—0·01 mgm. of nicotinic acid is easily detected—and the gradation of the colour produced is excellent for increments of 0·01 mgm. up to 0·1 mgm. of nicotinic acid. The whole procedure is simple.

The method has been applied to twelve foodstuffs. Further, known amounts of nicotinic acid were added to known amounts of yeast and raw milled rice and the recovery was good in both cases. The results are shown in Tables I and II.

TABLE I.

Name of Foodstuff	Nicotinic acid (mgm. %)
Yeast, dried (brewer's)	62·50
Skimmed milk powder	10·53
Wheat, whole	5·33
Ragi (*Eleusine coracana*)	3·08
Rice, raw, milled	2·38
Rice, parboiled, home-pounded	2·78
Cambu (*Pennisetum typhoideum*)	2·50
Cholam (*Sorghum vulgare*)	1·82
Maize, white	1·48
Soya bean	4·85
Red gram (*Cajanus indicus*)	5·33
Bengal gram	4·74

TABLE II.

Foodstuff + nicotinic acid	Total nicotinic acid present (mgm. %)	Total nicotinic acid found (mgm. %)	Error %
Raw milled rice 10 gm. + 1 mgm. nicotinic acid.	1·24	1·29	5
Dried yeast 10 gm. + 10 mgm. nicotinic acid.	16·25	15·85	−4

The colour reaction is probably given by all compounds containing the pyridine ring, and the assumption is made that nicotinic acid and its derivatives form the major portion of such compounds in most common foodstuffs. Further work is being undertaken to verify this point.

The low value of maize is particularly interesting, because of the association between pellagra and maize. While true pellagra is rare in India, a pellagra-like condition (stomatitis) is extremely common, and it is quite possible that deficiency of nicotinic acid is an important defect of Indian diets based on rice or millet.

M. SWAMINATHAN.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
March 7.

[1] Fouts, Helmer, Lepkovsky and Jukes, *Proc. Soc. Exp. Biol. Med.*, **37**, 405 (1937).
[2] Smith, Ruffin and Smith, *J. Amer. Med. Assoc.*, **109**, 2054 (1937).
[3] Elvehjem, Madden, Strong and Woolley, *J. Amer. Chem. Soc.*, **59**, 1767 (1937).
[4] Chick, Macrae, Martin and Martin, *Biochem. J.*, **32**, 10 (1938).
[5] Strafford and Parry-Jones, *Analyst*, **58**, 380 (1933).

Selective Oxidation as a Fundamental Principle in Metallic Protection

IT is known that the oxidation or tarnishing of iron and copper can sometimes be diminished by alloying with small amounts of aluminium, beryllium, chromium and silicon, and that some oxide films confer protection or even passivity—especially when they are so thin as to be invisible. Little has been done, however, to obtain reliable protection by controlling the composition of the films. Miyake[1] has noted that, in the case of copper containing more than 3 per cent aluminium, the oxygen content of the atmosphere used for the first heating is an important factor. Sloman[2] has recommended the introduction of beryllium into silver to prevent tarnishing, but the efficacy of this addition has been questioned by Raub[3], whose work suggests to us that some factor other than the composition of the alloy determines its behaviour.

A new derivation[4] of Wagner's expression[5] $(n_1+n_2)n_3xE/F$ for the velocity constant of tarnishing or oxidation reactions following the parabolic law (where x is the electrical conductivity of the reaction product, n_1, n_2 and n_3 the transport numbers of cations, anions and electrons respectively in the film and E_0 the affinity of the reactants for each other) has suggested the necessity of producing on the metal to be protected *a film of very low conductivity*. Alumina or beryllia will possess the required properties if pure; but the analogous case of silver chloride containing traces of cadmium chloride[6] considered in connexion with the work on the conductivity of alumina[7], suggests that small traces of silver or copper oxides in the alumina or beryllia film would greatly increase the conductivity, and therefore the rate of tarnishing or oxidation.

By pre-treating alloys containing aluminium or beryllium in a controlled atmosphere—designed to permit the oxidation of the alloying constituent only and at temperatures suitable for the necessary diffusion of this constituent to the surface—protective films of pure alumina and beryllia have been obtained in these laboratories. Application of this principle of selective oxidation has led to materials almost immune from 'tarnishing' and 'scaling'. A specimen of copper containing 5 per cent aluminium heated in air at 800° C. for four hours gained 50 mgm./sq. dm.,

developing a loose black scale; the same alloy previously heated in a hydrogen atmosphere containing water vapour at a partial pressure 0·1 mm. (which still permits sufficient oxidation to develop a film of *copper-free* alumina), remained quite undarkened and gained only 4 mgm./sq. dm. when heated under the same conditions. Similarly, silver containing 1 per cent aluminium was found to tarnish rapidly when exposed to a polluted atmosphere, whereas the same alloy pre-heated in damp hydrogen at 400° C. so as to produce an invisible film of *silver-free* alumina, suffered no change in appearance within thirty times this period; pre-heating in air at atmospheric pressure did not reduce the tendency to tarnishing.

Several other examples could be given and full results will be published shortly. It is hoped that this principle of selective oxidation will play an important part in overcoming the deterioration of metals.

G. J. THOMAS.
LAURENCE E. PRICE.

Goldsmiths' Metallurgy Laboratories,
University of Cambridge.
April 4.

[1] Miyake, S., *Sci. Papers Inst. Phys. Chem. Res. (Tokyo)*, **31**, 161 (1937).
[2] Sloman, H. A., *J. Inst. Met.*, **49**, 365 (1932).
[3] Raub, E., *Mitt. Forschungs Edelmetalle*, **8**, 77 (1934).
[4] Hoar, T. P., and Price, L. E., *Trans. Faraday Soc.*, 1938, Symposium on "Chemical Reactions involving Solids".
[5] Wagner, C., *Z. phys. Chem.*, B, **21**, 25 (1933).
[6] Koch, E., and Wagner, C., *Z. phys. Chem.*, B, **38**, 295 (1937).
[7] Jander, W., and Stamm, W., *Z. anorg. Chem.*, **199**, 169 (1931).

Effect of Succinic Acid on the Respiration of Normal Human Muscle and Various Myopathies

SUCCINIC acid has long been known to be oxidized rapidly by muscle and many other tissues. Experiments of Szent-Györgyi and co-workers[1] suggested that succinic acid and certain other dicarboxylic acids catalyse the aerobic respiration of muscle tissue. Conclusive proof for this catalysis in muscle tissue was given by Stare and Baumann[2], and its application to liver and kidney tissue was shown by Stare[3].

In current studies on the respiration of human muscle tissue, we have observed that in muscle taken from patients with myasthenia gravis and progressive muscular dystrophy, succinic acid fails to catalyse the aerobic respiration and is itself oxidized only to a very slight extent. Malonate was found to inhibit the respiration. With normal human muscle tissue we observed the expected catalytic result upon addition of succinic acid as well as malonate inhibition.

The experiments were done in Warburg manometers at a temperature of 38° C. and in a Ringer phosphate-glucose buffer at *p*H 7·4. The tissues were obtained by muscle biopsy and immediately ground in an ice-cold Latapie mincer. Succinate and malonate were added as the sodium salts in concentrations of 0·003 and 0·03 molar. The following table shows typical experiments:

Muscle	Condition	Q_{O_2}	Increase of Q_{O_2} with succinate (0·003 M.)	Increase of Q_{O_2} with succinate (0·03 M.)	Decrease of Q_{O_2} with malonate (0·003 M.)
Gastrocnemius	Myasthenic	3·9	+ 3 per cent	+ 8 per cent	− 47 per cent
Gluteal	Prog. muscular dystrophy	3·7	+ 5 „ „	+ 5 „ „	− 38 „ „
Abdominal rectus	Normal	3·4	+ 27 „ „	+ 50 „ „	− 60 „ „

The percentage increase in U_{O_2} values with succinate calculated at 90 and 20 minutes were even more striking than the Q_{O_2} values presented.

These results are of particular interest since they suggest that certain disturbances in the intermediary metabolism of normal muscle may be associated with these myopathies. These experiments are being continued and will be reported in detail in a forthcoming communication.

F. J. STARE.
E. S. GORDON.
M. J. MUSSER.

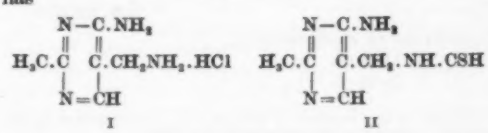
University of Wisconsin,
School of Medicine,
Madison.
March 23.

[1] Szent-Györgyi, A., and co-workers, *Z. physiol. Chem.*, **236**, 1 (1935).
[2] Stare, F. J., and Baumann, C. A., *Proc. Roy. Soc.*, B, **121**, 338 (1936).
[3] Stare, F. J., *Biochem. J.*, **30**, 2257 (1936).

Vitamin B_1 and Cocarboxylase

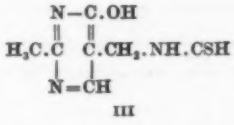
THE appearance of a paper by Lipschitz *et al.*[1] in which the authors consider that tissue extracts induce a synthesis of cocarboxylase from vitamin B_1 and phosphate by alkaline washed yeast prompts the publication of the facts below; they form part of an investigation on the phosphorylation of the vitamin suggested to me by Prof. R. A. Peters.

Lohmann and Schuster[2] found cocarboxylase to be vitamin B_1 pyrophosphate, but the vitamin itself was inactive as cocarboxylase. While confirming the latter fact, I find that the action of pure cocarboxylase is strongly stimulated by the addition of synthetic vitamin B_1. The graph which follows shows the activating effect of the vitamin on 1 γ cocarboxylase[3] using alkaline washed yeast and pyruvic acid. The pyrimidine group of the vitamin seems to be the one responsible for this activation. Pyrimidine I[4] has



I

II



III

about 1/10, pyrimidine II 1/30 the activity of the vitamin. Pyrimidine III, without the NH_2 group, is inactive up to 90 γ. This may be of significance in view of Langenbeck's findings[5] on artificial carboxylases. Thiazole (up to 90 γ) is inactive, as also is vicine, cytidylic acid (commercial specimen) and nicotinamide (up to 100 γ). The stimulation by the vitamin of the action of boiled tissue extracts is due to the presence of cocarboxylase in the latter.

The activation of the carboxylase reaction by vitamin B_1 is being explored for the estimation of both cocarboxylase and free vitamin B_1 in

biological material. These results will be reported elsewhere. In the meantime, it seems clear that the discovery of this particular activation makes necessary a revision not only of the conclusions quoted above[1], but also of other present evidence for the synthesis of cocarboxylase from vitamin B_1.

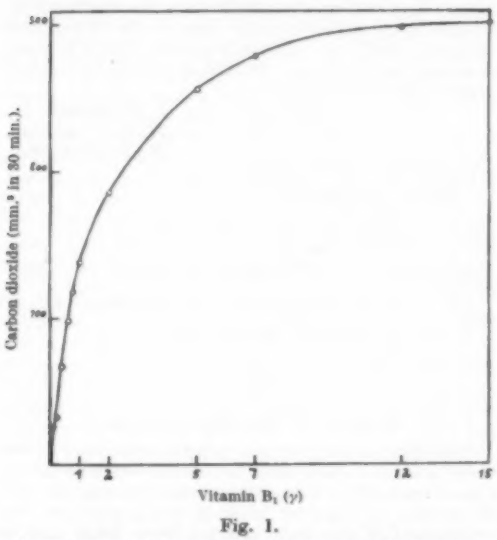


Fig. 1.

ACTIVATION OF COCARBOXYLASE ACTION BY VITAMIN B_1. ORDINATE, CARBON DIOXIDE EVOLVED IN PRESENCE OF VITAMIN AND 1 γ COCARBOXYLASE MINUS CARBON DIOXIDE EVOLVED BY 1 γ COCARBOXYLASE ALONE (1 γ COCARBOXYLASE = 163 mm.³ CARBON DIOXIDE; BLANK = 25 mm.³ CARBON DIOXIDE IN 30 MINUTES).

Thanks are due to the Rockefeller Foundation and the Nuffield Trust for financial help.

S. OCHOA.

Department of Biochemistry,
Oxford.
April 2.

* Samples kindly supplied to Prof. Peters; cocarboxylase by Dr. Lohmann, pyrimidines and thiazole by Dr. Todd.

[1] Lipschit, M. A., Potter, v. R., and Elvehjem, C. A., *Biochem. J.*, **32**, 474 (1938).
[2] Lohmann, K., and Schuster, Ph., *Naturwiss.*, **25**, 26 (1937) *Biochem. Z.*, **294**, 188 (1937).
[3] Langenbeck, W., *Ergeb. Enzymforsch.*, **2**, 314 (1933).

Magnitude of Nuclear Forces

IN a recent letter to NATURE[1] it has been shown that the degree of dissociation of a proton or neutron is very close to $q = \frac{1}{2}$.

It can be shown that the so-called method of second quantization leads to essentially the same behaviour of elementary particles as the elementary theory. The numerical value of the degree of dissociation, however, remains undetermined, since it is proportional to the square of the interaction constant between heavy particle and heavy electron field. Thus, combining both methods, it is possible to determine the numerical value of the interaction constant. We obtain in this way the potential energy of nuclear forces

$$V = \pm A^2 \frac{e^{-\varkappa r}}{r}$$

where $A = \sqrt{\frac{hc}{2\pi} \frac{2m}{M}}$.

The details of the theory will be published in the *Physical Review*.

GUIDO BECK.

Cité Universitaire,
45 Boulevard Jourdan,
Paris XIV. March 27.

[1] NATURE, **141**, 609 (1938).

Mechanism of the Primary Photodissociation Processes of Organic Molecules

Two rules have been derived experimentally from investigations of the continuous absorption spectra of inorganic molecules[1]. First, the action of light may produce the splitting of a single bond, the two products of dissociation, namely, atoms or radicals, possessing free valencies. This process occurs as long as the central atom of the original molecule is in a lower state of valency, molecule formation being brought about by its p electrons only. The first long wave limit then agrees with the single bond energy concerned. The second mechanism refers to molecules the central atom of which is in its maximal state of valency, its s electrons being responsible for chemical linkage in addition to its p electrons. In this case, one of the dissociation products does not possess free valencies, but is a saturated molecule of lower valency state in a $^1\Sigma$ term. Here, the first long wave limit is not correlated to a single bond energy, but agrees with the energy difference of the total energy of formation of the original molecule and that of the produced molecule of lower valency. In other words, the action of light produces a transition to that repulsive electronic state, which is due to the repulsive character of the s^2 group of electrons and predicted by the pair bond theory of valency, originally advanced by Heitler and London.

In organic molecules the carbon atom is in its state of maximal valency and hence the above view should hold for organic molecules too. Indeed it has been verified already for simple tetrahalides of carbon. In addition to methan halides we have now studied aldehydes and ketones, acids and derivatives, ketonic acids and esters, a few examples being shown below. We have measured the continuous absorption spectra of some of them, while for others we used figures from literature, particularly the predissociation data as reported for aldehydes and ketones by Henri[2]. The results are in fair agreement with the theory, if we assume the following processes:

(1) $CI_4 \rightarrow CI_2(^1\Sigma) + 2I.$

(2) $\begin{matrix} H \\ \diagdown \\ \quad C=O \\ \diagup \\ H \end{matrix} \rightarrow 2H + CO(^1\Sigma).$

(3) $CH_3.CO.CO.CH_3 \rightarrow CO(^1\Sigma) + CH_3 + CH_3.CO.$

(4) $CH_3.CO.OC_2H_5 \rightarrow CO(^1\Sigma) + CH_3 + OC_2H_5.$

(5) $CH_3.CS.SH \rightarrow CS(^1\Sigma) + CH_3 + SH.$

Particular attention may be directed to the large shift of the predissociation point from the ultra-violet (λ 2750) in formaldehyde to the visible spectrum (λ 4395) in diacetyl, which is perfectly represented by the above theory. Also the long wave limits of

further regions of selective continuous absorption in the far ultra-violet, measured for some such molecules, are capable of interpretation on these lines, comprising higher repulsive states of a similar character.

Substance	Process	Energy required: calculated K.cal./mol.	observed: λ (A.)	observed: K.cal./mol.	Remarks	Author
Carbon tetra-iodide	(1)	70	3930	72	L. W. L.	Samuel and Parti[1]
Formaldehyde	(2)	104·5	2750	103	Pr. D.	Henri and Schou[2]
Diacetyl	(3)	66	4395	64·5	Pr. D.	Henri[2]
Ethylacetate	(4)	108	2630–2420	108–117	L. W. L.	Present paper
Dithioacetic acid	(5)	84	{ 3010	94	L. W. L.	,, ,,
			{ 3360	84	Min. Sol.	,, ,,

L. W. L. = Beginning of continuous absorption (vapour). Pr. D. = Predissociation of band spectrum. Min. Sol. = Minimum of absorption curve of hexane solution.

In all such cases two bonds of the absorbing molecule appear to be broken simultaneously without involving two single bond energies, but by the direct transition from the ground state to a repulsive term, correlated to a saturated molecule of lower valency. A strict application of the pair bond theory seems, therefore, to offer an explanation of certain features of the spectra of organic molecules and, as we hope, of certain photochemical reactions and processes at the same time. This will be discussed at greater length in a forthcoming paper.

Daniel Sieff Research Institute, Rehovoth. ERNST BERGMANN.
Hebrew Technical Institute, Haifa. R. SAMUEL.

[1] Samuel, R., "Absorption Spectra and Chemical Linkage", Symposium Ind. Acad. Sci. (Bangalore, 1934). Asundi, R. K., and Samuel, R., *Proc. Phys. Soc.*, **48**, 28 (1936). Jan-Khan, M., and Samuel, R., *ibid.*, **48**, 626 (1936). Parti, Y. P., and Samuel, R., *ibid.*, **49**, 568 (1937). Hussain, S. L., and Samuel R., *ibid.*, **49**, 679 (1937). Samuel, R., *Proc. Ind. Acad. Sci.* (*Bangalore*), **6**, 257 (1937).
[2] Henri, V., "Structure des Molecules" (Paris, 1925).
[3] Henri, V. and Schou, S. A., *Z. Phys.*, **49**, 774 (1928).

Band Spectrum of Silicon Monosulphide

IN a recent paper[1] on the ultra-violet band system of GeO, a survey was made of the band systems of the monoxides and monosulphides of the Group IV (*b*) elements which appear to be analogous to the "Fourth Positive" system ($A^1\Pi \rightarrow X^1\Sigma$) of CO and the well-known ultra-violet systems of CS and SiO. For SiS, the only molecule of the sub-group for which no data were available, the character and approximate position of the corresponding band system were predicted graphically.

Using heavy-current (3–5 amp.) discharges through a mixture of SiS vapour and argon in a tube of the type recently described by Pearse and Gaydon[2] and also in an all-silica tube, we have observed in the region λ2576–λ3876 a system of some seventy to eighty bands degraded to the red. The heads are approximately represented by $\nu_{head} = 35028{\cdot}5 + (512{\cdot}9u' - 2{\cdot}88u'^2 - 0{\cdot}006u'^3) - (749{\cdot}6u'' + 2{\cdot}58u''^2)$ where u is written for $v + \frac{1}{2}$. The rotational structure of the stronger bands in high dispersion appears to be of the well-known three-branch type given by a $^1\Pi \rightarrow {}^1\Sigma$ transition. That the lower state is the ground state of SiS is proved by our further observation of a few of the bands (about eight strong bands with $v'' = 0$ and 1) in absorption by SiS vapour at about 1000° C.

In the SiS discharge also are some seventy to eighty bands extending from λ3491 to λ6169, which are similar in appearance and distribution to bands in the longer-λ sequences of the above system. They appear to form part of another system, the upper and lower states of which are different from, but have vibrational frequencies of the same order as those of the ultra-violet system. The emitter may be SiS, which is expected to have triplet as well as singlet states.

The ultra-violet system of SiS is well developed also in a heavy-current discharge through Al_2S_3 vapour in a silica tube. In this source, however, the well-known $^3\Sigma \rightarrow {}^3\Sigma$ system of S_2 (of which there is, fortunately, no trace in the SiS discharge) is prominent, and the second set of bands cannot be detected.

R. F. BARROW.
W. JEVONS.

Imperial College,
London, S.W.7.
April 7.

[1] Jevons, Bashford and Briscoe, *Proc. Phys. Soc.*, **49**, 543 (1937).
[2] Pearse and Gaydon, *Proc. Phys. Soc.*, **50**, 201 (1938).

Fluctuation Noise in Thermionic Valves

IN a recent paper[1], I put forward the theory that the noise generated by a thermionic valve is alternatively (*a*) of the shot noise type if the valve anode current is temperature-limited, *or* (*b*) of the thermal or 'Johnson noise' type if the current is fully space-charge limited. (Contrast Llewellyn's theory that the noise in the presence of space-charge is the *sum* of shot and thermal noise, with a smoothing factor applied to the shot noise.) In the paper quoted, however, there was no quantitative treatment of the practical case of a valve which is partially space-charge limited, that is, does not correspond exactly to either of the simple states of temperature or space-charge limitation.

It has now been found possible to treat this practical case with moderate accuracy by dividing the current into two parts. Assuming the law of the valve under investigation to be known for the fully space-charge limited condition (for example, $i_a = bV_a^{3/2}$ for a diode), the proportion of the observed anode current which is fully space-charge limited can be deduced by comparing the slope of the measured i_a/V_a characteristic with the calculated value for an equal current with full space-charge limitation; when the current so calculated has been subtracted from the total measured current, the residue is current which is temperature-limited. The total noise output of the valve is then the sum of (*a*) the thermal noise in the measured resistance (calculated in accordance with the methods given in the paper already quoted), and (*b*) simple shot noise arising from the residual current which is temperature-limited.

This method has been applied numerically to two diodes, and it is hoped to extend it to triodes before full details are published.

D. A. BELL.

Eastlea,
Great Baddow,
Chelmsford.
March 26.

[1] "A Theory of Fluctuation Noise", paper read before the Wireless Section of the Institution of Electrical Engineers on Jan. 5, 1938.

Elastic Constituent of Rubber

IN a recent paper[1] K. C. ROBERTS has described the isolation from dried fresh *Hevea* latex of small quantities of a highly elastic substance which he has named caoutchol and to which he has ascribed the formula $C_{30}H_{138}(OH)_2$. This substance has been shown to possess the high degree of elasticity hitherto regarded as characteristic of rubber; the rubber hydrocarbon purified by its removal is comparatively non-elastic.

The X-ray photograph of freshly prepared caoutchol, unstretched, at room temperature (35° C.), shows certain sharply defined rings identical with those reported by W. H. Barnes[2] for 'frozen' rubber. Other rings, however, exhibit significant differences. At 700 per cent extension, caoutchol gives an X-ray photograph almost identical with that obtained from stretched, air-dried, fresh latex, the transition from the rings of the Debye-Scherrer diagram to the sharply defined spots of the fibre pattern being clearly visible.

The purified rubber hydrocarbon, to which Dr. Roberts has given the name caoutchene, does not show the sharply defined rings characteristic of caoutchol nor can it be extended sufficiently to give the fibre characteristic of stretched rubber. The X-ray evidence therefore supports the theory that the minor constituent caoutchol is the primary factor in the elasticity of rubber.

The detailed results of this work, together with further X-ray observations on derivatives of caoutchene and caoutchol, will be published elsewhere.

T. C. ROBERTS (née MARWICK).

Rubber Research Institute of Malaya,
Kuala Lumpur, F.M.S.
March 22.

[1] Roberts, K. C., *J. Chem. Soc.* (Feb. 1938).
[2] Barnes, W. H., *Canadian J. Research*, B, **15**, 156 (1937).

Food of the Partridge

JUST a quarter of a century ago I concluded an investigation on the food and feeding habits of the partridge, and my results were set forth in the *Journal of the Land Agents' Society* (June 1917), and in further detail in *Science Progress* (Oct. 1918). I found an examination of crop, intestine and stomach contents over a period of five years to "show that of the total bulk of food consumed 59·5 per cent. is vegetable matter and 40·5 per cent. animal matter. Of the former 53·5 per cent. consists of leaves, fruits, and seeds of weeds, 3·5 per cent. of grain, and 2·5 per cent. of miscellaneous vegetable matter. Of the animal matter, 23 per cent. consists of injurious insects, 3 per cent. of beneficial species, 4 per cent. of neutral species, 6·5 per cent. of earthworms, and 4 per cent. of slugs complete the summary." These facts were repeated in my work on "The Food of Some British Wild Birds" (1924–27).

In November last, Mr. A. D. Middleton and Miss H. Chitty published an interesting paper on this subject in the *Journal of Animal Ecology* (which I have only just seen), in which they state "Perhaps the most striking are the large quantities of green food eaten during the winter and spring months and the very low percentage of animal food. For some reason, partly due to the publications of Collinge, insects have for a long time been regarded as an important and even essential part of the food of partridges."

With all respect, as one who has devoted more than thirty years of his life to such investigations, I think I may say that Mr. Middleton and Miss Chitty have failed to realize one of the most important results of their work, namely, that since I carried out my investigation on the nature of the food of the partridge, in 1912 and 1913, this bird has changed its food habits, just as the rook and the starling have in that period. Like these authors, I chronicled exactly what I found in the stomach and intestines, they in the crops, and the two records show conclusively the change that has taken place. There can be little doubt that this change has not been beneficial to the partridge as a species, for, for some years past, the mortality due to strongylosis and coccidiosis and other causes have been enormous.

It is clear to me that here we have a very striking case of reduced vitality due to a change in diet, and it shows how important it is, as I have previously advocated, that from time to time all such investigations should be repeated, in order that the true economic status of any particular species of wild bird should be ascertained.

WALTER E. COLLINGE.

The Yorkshire Museum,
York.
April 25.

Cytology of Metamorphosis in the Culicinæ

A NUMBER of investigators[1] have distinguished two main types of larval insect tissue with respect to growth and metamorphosis. Many tissues grow by increase in cell size and undergo disintegration at metamorphosis, the corresponding adult tissue being formed from imaginal disks that were not functional parts of the larval tissue. The second class of tissues grow by cell division and multiplication, and are carried over, with or without modification, into the adult.

The epithelium of the larval ileum of *Culex pipiens* behaves in a manner intermediate to the two methods described above. Larval growth is accomplished solely by increase in cell size, and at metamorphosis the adult tissue is formed by the simultaneous division, reduction in size and increase in number of these same larval cells. In this case great increase in cell size is not accompanied by inability to divide or to undergo further differentiation.

These phenomena, first observed in *Culex pipiens*[1], have during the past year been found in the following other species collected in Maryland: *Culex apicalis* Adams, *C. territans* Walker, *Aedes canadensis* Theobald, *A. triseriatus* Say, *Orthopodomyia signifer* Coquillett, and *Anopheles punctipennis* Say. Metamorphosis of this type is probably present throughout the sub-family Culicinæ.

All seven species have a diploid number of six chromosomes. The following cytological peculiarities, first studied in *Culex pipiens*, have since been found in the other six species of mosquito: (*a*) increase in the chromosome number of larval cells, accompanying increase in size and apparently taking place within the resting nucleus; (*b*) multiple chromosome complexes of 192, 96, 48, 24 and 12 chromosomes appearing during the mitoses effecting metamorphosis, and showing a direct correlation between chromosome number and cell size; (*c*) prophase synapsis of high

multiples of sister and homologous chromosomes with no formation of chiasmata.

Considerable indirect evidence favours the interpretation that these divisions are somatic reduction divisions. Decisive evidence is being sought by attempting to observe the process in the living organism.

CHARLES A. BERGER.

Johns Hopkins University,
and
Woodstock College,
Maryland.
March 10.

[1] cf. Trager, W., *J. Exp. Zool.*, **78**, 467 (1937).
[2] Berger, C. A., *Anat. Rec.*, **67**, *Supp.*, **1**, 63 (1936); Berger, C. A., *Genetics*, **23**, 140 (1938); Berger, C. A., *Carnegie Inst. of Wash., Contrib. to Embryol.*, 27 (in the Press).

Absorption of Growth-Promoting Substances by Cuttings

ABOUT two years ago a batch of leafless cuttings of *Bougainvillea* (var. Mrs. Louis Walthen) was received at these laboratories for propagation. They were planted in our usual propagators. The majority threw out small shoots but there was no callussing or root development. After eighteen months it was decided to try the effect of a proprietary root growth-promoting substance. The cuttings still alive were treated in the normal way, that is, by immersion of the basal ends in a dilute solution for eighteen hours. However, no callussing or rooting took place and it is assumed that this was due to lack of transpiration in the cuttings, which were leafless when treated.

Finally it was decided to try the effect of forcing the growth-promoting substance into the cuttings now almost exhausted of food reserves. The ends of the cuttings were cut off to expose fresh surfaces. The lower ends were submerged to a depth of one inch in the solution contained in a vacuum desiccator which was exhausted until a strong stream of bubbles emerged from the bottom end of each cutting. On breaking the vacuum the solution was forced into the submerged ends. Two or three months after replanting the cuttings, 90 per cent rooted and are now healthy plants.

The experiment was not planned as a test of the growth-promoting substance, but was made in a final attempt to save the last remaining cuttings of a variety new to Kenya. So striking have been the results that the suggestion is put forward that possibly failure to secure rooting with winter cuttings of deciduous plants after treatment with various growth-promoting substances has been due to non-absorption, or to the absorption of too little of the material by the leafless cuttings.

T. H. JACKSON.

Scott Agricultural Laboratories,
Department of Agriculture,
P.O. Box 323,
Nairobi, Kenya.
March 22.

Probable Fossil Hail Impressions in Natal Coal Measures (Middle Ecca Series)

DURING the course of a geological survey of the Verulum district, Natal[1], some peculiar little depressions were noticed on the upper surfaces of freshly exposed slabs of lower Middle Ecca (Permian) sandy shales occurring in a small road-metal quarry situated on the main road between Verulum and Tongaat, a little north of the Shortlands Hotel. The depressions appeared to be confined to a single horizon which, owing to the lack of exposures, could not be traced beyond the confines of the quarry.

The depressions, which are circular to slightly elliptical in outline, are bounded by slightly raised edges. In size they are remarkably uniform, averaging about 14 mm. in diameter and 5 mm. in depth, while in shape casts showed that they are slightly assymmetric, the steeper sides being usually similarly orientated.

Specimens cut perpendicularly to the bedding revealed that the laminæ immediately under the depressions were arched down as though the latter had been caused by blows. Their casts in the overlying horizon were found to be slightly coarser grained than the bounding layers and invariably plano-convex in shape.

It has been indicated by Twenhofel[2] that the maximum depth of rain-drop impressions appears to be 3 mm. and their maximum width 12 mm. It would seem, therefore, that some other natural origin should be postulated for these depressions. Their character seems to suggest that they were caused by the impact of hailstones, since their relatively great depths in proportion to their diameters eliminates the possibility of their being splash impressions.

Twenhofel[2] also figures artificial hail-impressions in mud which are characterized by very steep sides and relatively great depths. Preliminary observations made during actual hailstorms and experiments made by dropping ice spheres indicate, however, that even in highly plastic muds, a layer of water only a few millimetres in thickness over the surface of the mud suffices to modify the effects considerably—shallower and more regular plano-convex depressions resulting. Futhermore, if the hail falls on exposed sand or sandy mud, shallower depressions result, provided that other factors such as the size, shape and velocity of the stones remain constant. In the case of only slightly plastic moist sands, secondary minor depressions, either adjacent to or overlapping the major direct ones, are formed owing to the bouncing of the hailstones.

In the present area the unconsolidated material was a sandy mud which, as fossil rain-prints, etc., noted in other portions of the Verulum area indicate, was on occasion exposed to sub-aerial conditions. Incidentally, depressions identical in appearance with those on the sandy shales were produced by dropping small rounded hailstones from a height of 15 ft. into a sandy mud which was covered by a 2 mm. film of water.

With one exception[3], these would appear to be the first impressions tentatively attributed to the action of hail which have been recorded from the whole geological column. The re-examination of reported 'rain print' localities in the light of experimental evidence would, however, appear to be desirable.

LESLIE E. KENT.

Geological Survey,
Pretoria,
Union of South Africa.

[1] Kent, L. E., "The Geology of a Portion of Victoria County, Natal", *Trans. Geol. Soc. S. Africa*, **41**, 1–36 (1938).
[2] Twenhofel, W. H., "Treatise on Sedimentation" (2nd Edition. 1932), p. 680.
[3] Lyell, Sir Charles, "On Fossil Rain-marks of the Recent, Triassic, and Carboniferous Periods", *Quart. J. Geol. Soc. Lond.*, **7**, 243 (1851).

Heavy Electrons in Cosmic Rays

A LETTER under this title appeared in NATURE of April 16. In the table on p. 685, the values of the momentum of the particles *a*, *b*, *c* and *d* (col. 4) should have been given as 69, 110, 95 and 73 respectively, instead of 65, 107, 86 and 67. The errors arose from an unnecessary alteration of the completed table, under the impression that some early preliminary data had been quoted. The masses in the last column correspond to the correct values of the momentum. We would also add that the results of Nishina and his collaborators, referred to in the above letter are in accord with ours for particulars *a*, *c* and *d* rather than *b*.

E. J. WILLIAMS.
E. PICKUP.

Illusion of Convergent Beams of Light

'CONVERGENT' beams similar to those reported by J. J. Hopfield[1] and A. C. Klebs and others[2] can be observed near lighthouses.

The effect was frequently observed by me in Scheveningen in Holland and corroborated by others, from a road running parallel to the shore between the lighthouse and the sea.

At evenings when in a slight haze the rotating beam of light from the lighthouse could be followed to the opposite horizon, the light beams seemed to converge towards the opposite horizon in such a way that a rotating beam of light appeared to be issuing from this horizon opposite the lighthouse, giving a strong impression that a second lighthouse, issuing a rotating beam of light, was out at sea beneath the opposite horizon.

The phenomenon is different from those observed with sunbeams in so far as the beams from the lighthouse are really diverging, practically from a nearby point, whilst the sunbeams are parallel. It is interesting that similar 'convergent' beams can be observed in both cases.

A. H. ROSENTHAL.

68 Ladbroke Grove,
London, W.11.

[1] NATURE, **141**, 333 (1938).
[2] NATURE, **141**, 558 (1938).

Points from Foregoing Letters

THAT yeast cells, transported by wind, may be carriers of various viruses, including that responsible for foot-and-mouth disease, is suggested by Prof. R. C. McLean, who points out that methods of acquiring immune strains of animals might be the only way of preventing the disease.

The discovery of a complete right jaw-bone, with several teeth, attributed to *Australopithecus*, is reported by Dr. R. Broom. The reconstructed face agrees fairly closely with that of the chimpanzee but the teeth are human. The author suggests that man may have arisen from *Australopithecus* by a mutation resulting in a large brain.

A method of gilding copper by applying a melted gold-copper eutectic (80 per cent gold, 20 per cent copper) which was apparently used by the pre-Columbian Indians is described by P. Bergsøe. The alloying was used, apart from purposes of decoration, to increase the hardness of certain articles, such as fish-hooks.

A colorimetric method for the estimation of nicotinic acid—the probable pellagra preventive factor—has been developed by M. Swaminathan. The nicotinic acid content of twelve common foodstuffs, as determined by the method, is also given. Values ranged from 1·48 mgm. per cent for maize up to 62·50 mgm. per cent for dried brewer's yeast.

By heating alloys of copper or silver containing a small percentage of aluminium or beryllium in an atmosphere of hydrogen and water vapour, under controlled conditions which allow selective oxidation, G. J. Thomas and Laurence E. Price have obtained protective films of alumina and beryllia which render the metals almost immune from tarnishing and scaling. The authors explain how they were led to their experiments by theoretical considerations on the electrical conductivity of surface films.

Dr. F. J. Stare, E. S. Gordon and M. J. Musser have observed that succinic acid does not catalyse the aerobic respiration of skeletal muscle tissue obtained from patients with myasthenia gravis and progressive muscular dystrophy, and that it is oxidized only to a slight extent. The usual catalytic effect was observed with normal human muscle. The results are of interest as they suggest that disturbances in the succinic acid cycle may be associated with these muscular diseases.

A graph showing the activating effect of synthetic vitamin B_1 upon the production of carbon dioxide through the action of cocarboxylase is given by Dr. S. Ochoa. The pyrimidine group of the vitamin appears to be responsible for activation, and previous views on cocarboxylase action may have to be revised.

Dr. E. Bergmann and Prof. R. Samuel advance a theory of photodecomposition of organic molecules according to which two bonds are fissured simultaneously, not by the splitting of two single bonds, but by a transition of the molecule to a repulsive state, which is produced by the repulsive character of the s^2 group of electrons of the central atom.

R. F. Barrow and Dr. W. Jevons announce the observation and vibrational analysis of the predicted ultra-violet band system of SiS, which corresponds to the "Fourth Positive" system of CO.

D. A. Bell states that the total noise output of a radio valve can be considered as made up of (*a*) the thermal noise in the measured resistance and (*b*) simple shot noise arising from the residual current, which is temperature-limited. This view has been applied to the case of diode valves.

X-ray studies of rubber constituents show, according to Dr. T. C. Roberts, that the highly elastic caoutchol, when stretched, gives X-ray patterns similar to those of stretched raw rubber. The author considers that this minor constituent of rubber is responsible for its elastic properties, rather than the major constituent, caoutchene, which does not show such an X-ray pattern.

Prof. C. A. Berger reports a new method of insect metamorphosis found in seven species of mosquitos from four genera. Cytological peculiarities present throughout the group throw new light on chromosome pairing and the origin of polyploidy.

Research Items

Woman's Status in Manam, New Guinea

MISS CAMILLA H. WEDGWOOD opens a study of women in Manam, an island about ten miles off the north-east coast of New Guinea, with an examination of the status of the women in Manam society (*Oceania*, 7, 1937, 4: Sydney Univ. Reprints, ser. 12, 2, 15–18, 1937). The belief that women in the islands of the west Pacific have a very low status has some support; but it is not possible to make any statement which will be valid for the whole. In Manam the social differentiation between the sexes is marked in almost every department of daily life. The women have their distinctive dress and modes of doing their hair, their distinctive occupations, and even their way of sitting and carrying their loads. Any departure from these distinctions provokes comment or ridicule. At gatherings in which both men and women are present the sexes sit apart and carry on conversation within the separate groups. In the economic sphere the differences between men and women are very sharply emphasized; but there is no ritual prohibition against a man doing a woman's work, or *vice versa*. For a man to fill and carry the drinking vessels from the water-hole, however, or to boil food in a pot, would be considered somewhat degrading for him; and the women would be as ready as the men to laugh at him for doing this; but he breaks no taboo thereby. It is considered equally ridiculous and wrong for a woman to ape a man; but there is nothing reprehensible for a woman to be skilled in some of the crafts which are usually known only to men. On the contrary, such a woman is often respected for her skill. The men generally assume that they are superior to the women, who are debarred from taking part in the sacred rites of the men, a privation justified by their inferior worth. Their interests, conversation and quarrels are trivial, when compared with the 'important' matters men discuss. To a great extent, the women echo the opinions of the men concerning their sex.

The Mammals of Ireland

SINCE William Thompson's description of the mammals of Ireland was published in 1856, no comprehensive account of the group has appeared. In the twenty-second report from the Fauna and Flora Committee, C. B. Moffat has brought the subject up to date by gathering together the scattered information which has accumulated in three quarters of a century, and commenting upon the present status of the 55 representatives of the Irish mammalian fauna (*Proc. Irish Acad.*, **44**, B, 61; 1938). The greatest change occurs in the Cetacea, where 10 species are recorded as new to the fauna. Of land mammals Ireland possesses only 33, in contrast to the 54 which are present in Great Britain. The most noticeable blanks occur amongst the rodents, where voles are unrepresented; the insectivores, which include only the hedgehog and the lesser shrew; and the bats. Additions to the fauna include the Egyptian mouse (*Mus musculus orientalis*), the tree rat (*Rattus rattus frugivorus*), and the deliberately introduced grey squirrel, which is well established in Co. Longford. The Irish stoat and mountain hare are now regarded as specifically distinct from the British forms. The author notes that since the European War marked changes have occurred in the numbers of some members of the fauna: rabbits and mountain hares have increased, as well as some of the beasts of prey such as the fox and badger, while others, like the hedgehog and the red squirrel, appear to be declining. The latter, although once a native of Ireland, is now represented only by descendants of introduced individuals.

Nest-building of the Bush-tit

IN an account of the behaviour of the Californian bush-tit (*Psaltriparus m. minimus*) Alice Baldwin Addicott gives some interesting details about nest-building (*Condor*, **40**, 49; 1938). The completed nest is a delicate suspended structure with a hood, very like that of the European penduline tit. The first step in the construction of the nest is the weaving of a horizontal rim, held together by spider's web and attached between a forked branch or two adjacent twigs. From the rim a loose bag is generally suspended, built by the birds as they perch upon the rim and work, head downwards, at the inside surface, to which strengthening materials are added. The last process is the construction of the hood and of the final side entrance which supersedes the first rim opening. The nest is made of mosses, lichens, oak leaves and spider's web, so blended that externally the structure is inconspicuous in its surroundings; the inside is lined with spider's web, down or feathers. The time taken in building varied from 13 to 51 days, the average being just over 33 days, but it was noticeable that nests built later in the season were more rapidly completed than early nests, and the opinion may be hazarded that, since many pairs nest a second time, the increased speed of construction was due to practice.

Marine Plankton Animals as Indicators of Water Movements

THE belief that certain plankton animals may serve as indicators of water movements has long been held by some marine biologists; but it was not until the publication of a paper by F. S. Russell in 1935 (*J. Mar. Biol. Assoc.*, **20**, 309–331) that their value for this purpose in British waters was clearly demonstrated. At the western entrance to the English Channel—the area studied by Russell—the most useful indicator animals were found to be certain members of the chætognath genus *Sagitta*, three species of which occur in that locality. Following upon Russell's researches, J. H. Fraser studied the occurrence and distribution of chætognaths in Scottish waters in 1936 (*J. Conseil Perm. Intern. pour l'Explor. de la Mer*, **12**, No. 3, 311–320; 1937). Six species or sub-species of *Sagitta* and one species of *Eukrohnia* were collected, all of which revealed well-marked correlations with different water masses. *S. setosa* was distributed over the whole of the North Sea and extended as far as 61° N. except where there was some oceanic influence; *S. elegans* was found to belong to mixed oceanic and coastal waters (cf. Russell's 'western water'); *S. serratodentata* was more truly oceanic; *S. maxima* belongs to the deeper oceanic waters (below 600

metres) and is brought into shallow water by upwelling along the edge of the continental shelf; *S. hexaptera* is typical of the epiplankton of tropical and sub-tropical regions, but a few individuals were taken in the Faroe-Shetland Channel, probably indicating an influx of some warm Atlantic water. Both this species and *S. maxima* quickly die on reaching Scottish waters. *E. hamata*, like *S. serratodentata*, is an oceanic form of more general distribution but belongs to a slightly deeper habitat. This work on Scottish chætognaths, although only a preliminary survey, is a useful contribution to our knowledge of plankton animals as indicators of water movements. Analyses of additional collections made over a number of years in the same region are contemplated and should furnish further information of great interest and value.

History of the Peach

THE community of gardeners has to thank Mr. E. A. Bunyard for many scholarly dissertations upon the histories of various cultivated plants. Peaches and nectarines have lately claimed his attention (*J. Roy. Hort. Soc.*, **63**, Parts 3 and 4, March and April 1938). The first mention of the peach in literature is, according to Bretschneider, contained in a Chinese manuscript of 551 B.C., and there can be little doubt that China was the original home of this fruit. The Romans probably obtained peaches through Persia, and peach stones of present-day size were excavated from Pompeii. Representations upon frescoes in that city's ruins also show fruits equal in dimensions to those of modern times. The peach was known in England during Anglo-Saxon times, and became somewhat notorious in 1216, when King John died "from a surfeit of peaches and ale". Thomas Rivers of Sawbridgeworth, his son and grandson, together introduced more than twenty-seven new varieties of peaches and nectarines, whilst a particularly early fruiting type was developed in America. Mr. Bunyard also deals in detail with the cultivation of the peach and nectarine.

Artificial Doubling of Chromosomes

A. F. Blakeslee and A. G. Avery have used the alkaloid colchicine to bring about doubling of the chromosomes of certain plants. A short paper in the *Gardeners' Chronicle* of April 16 outlines the process, and cites further papers where greater detail is published (for example, *J. Hered.*, **28**, 392–411; 1937; or U.S. Dept. Agric. Year Book, separate No. 1605, 1–35; 1938). Solutions of the amorphous product in strengths varying from 0·0004 per cent to 0·4 per cent have been used. Seed of *Datura*, for example, was soaked in a 0·2–0·4 per cent solution for 4–10 days before planting. Plants grown from treated seed are often at first stunted and malformed, and it is only in the succeeding generation that individuals with doubled chromosomes may be expected. The discoverers of this treatment have shown considerable restraint in their interpretation of the experimental results, but great possibilities may be envisaged when more detail is made available.

New Zealand Earthquake of 1934

THE Pahiatua earthquake of March 5, 1934, is described by Mr. R. C. Hayes in *Bulletin* No. 122 of the Wellington Dominion Observatory. The region most severely shaken lay along the east coast of the North Island, about fifty miles south of Hawke's Bay, and the shock was felt at Dunedin, 460 miles from the epicentre, or to about the same distance as the great earthquakes of 1929 and 1931 were felt. So far as can be judged from the records of the seismographs that were not dismantled by the shock, the epicentre was submarine, in lat. 40° 57′ S., long. 176° 48′ E., or about thirty miles east of Castlepoint. The focal depth is uncertain, but probably lay between 20 km. and 40 km.

New Radioactive Silver Isotope

RECENT investigations on the artificial production of radioactive silver isotopes have led to the discovery of four more isotopes, in addition to those with half-life periods of 2·3 min. and 23 sec., respectively, discovered by Fermi and his co-workers. ^{106}Ag occurs in two isomeric forms, one of which emits positrons, and has a half-life period of 24·5 min., whilst the other gives electrons, and has a half-life of 8·2 days. Both are obtained, with others, by bombarding silver with rapid neutrons, the process being ^{107}Ag $(n, 2n)$ ^{106}Ag. ^{108}Ag has a half-life of 2·3 min., ^{110}Ag one of 23 sec., ^{111}Ag one of 7·5 days, and ^{112}Ag one of 3·2 hours. ^{107}Ag and ^{109}Ag are stable isotopes. Further experiments by H. Reddemann and F. Strassmann (*Naturwiss.*, **26**, 187; 1938) on the bombardment of silver foils in paraffin with slow neutrons for long periods (2 months), have indicated the existence of a new active isotope, with a half-life as long as 190 ± 40 days. That the activity was indeed due to silver was confirmed by chemical separation. It is probable that the isotope is produced by a (n, γ) process, and may be an isomeric nucleus of atomic weight 108 or 110.

Field Due to Two Nuclei

IN wave mechanics one often meets the problem of an electron acted on by two centres of force. This is the fundamental problem of molecular forces or of chemical valency, and also arises in the study of the spectra of atoms such as helium. A summary of the present state of the problem and a new contribution to the subject are given by E. A. Hylleraas (*Ann. de L'Institut Henri Poincaré*, **7**, 121; 1937). The usual approximate treatment replaces a non-central and non-statical field by the central statical field which is the average of the true field. This works fairly well for some purposes, but is unsatisfactory for the calculation of the polarization produced by an external electron. For molecules, there are two methods often employed. Heitler and London form the characteristic functions for a molecule from those of isolated atoms, while the other method uses the functions for an electron due to two nuclei. The first method works best for large atomic distances, the second for small. For moderate distances both are unsatisfactory unless certain corrections are made. Dr. Hylleraas treats in detail the simplest case, where the two centres have equal charges, as in the hydrogen molecule-ion. The wave equation separates into two, the interior and the exterior equation. A new method of treating these is suggested, which should lead to a complete solution in the exterior case, but further calculations are required before its value in the interior case can be estimated.

Chemical Reactions Involving Solids*

Physical Basis

INTRODUCTORY papers by Profs. N. F. Mott (Bristol) and J. C. Slater (Cambridge, Mass.) dealt with the motion of electrons in polar salts. Electrons can be set free by the absorption of light or by the heat motion of the atoms of a crystal; however, the absorption of light will not necessarily free an electron; an atom of the crystal may be raised merely into an excited state, without the electron being free to move far away from its original position. An excited atom in a crystal has been termed an 'exciton'; an exciton can move a certain distance through the crystal by transferring its energy from atom to atom, before the energy is all dissipated. The various types of lattice imperfection at which an electron can be trapped were also discussed.

Papers by Prof. J. D. Bernal (London), Prof. G. Hevesy (Copenhagen), H. A. C. McKay (London), Prof. C. Wagner (Darmstadt), Prof. W. Jost (Hanover), Dr. T. P. Hoar and Dr. L. E. Price (Cambridge), and Dr. J. A. A. Ketelaar (Leyden), dealt mainly with the transport of atoms and ions through solids. Experiments on self-diffusion in metals were described, using natural and artificial radioactive materials as indicators. A hypothesis was advanced to account for the small values of the coefficients of self-diffusion, compared with the coefficients of diffusion of one metal into another. Ionic conductivity and diffusion in solid polar salts were discussed in the light of the theory that there exist in a polar salt in thermodynamical equilibrium a certain number of vacant lattice points and a number of ions in interstitial positions. Experimental and theoretical methods of estimating the activation energies necessary for the formation of these configurations were described. Finally an account was given of the behaviour of salts of very high conductivity, for example, α-Ag_2HgI_4.

Photochemical Processes

A number of papers dealt with photochemical reaction in solids. Dr. R. Hilsch and Prof. R. W. Pohl (Göttingen) demonstrated a beautiful experiment in which a transparent crystal of potassium bromide containing KH in solid solution is coloured blue on exposure to ultra-violet light, the well-known *Farbzentren* being formed. The efficiency of the photochemical reaction falls rapidly, however, as the temperature is lowered. Prof. J. Eggert and M. Biltz (Leipzig) described experiments on the sensitivity of the silver bromide photographic layers; they considered that *Störungstellen* in the halide grains have two functions: to serve as nuclei for the formation of the latent image, and, for wave-lengths greater than 500 mμ, to make possible the absorption of light.

Papers by Dr. C. F. Goodeve and J. A. Kitchener (London) dealt with photosensitization by solids, and by Prof. W. Reinders and Dr. M. C. F. Benkers (Delft) with the physical development of the latent image. Dr. Lüppo-Cramer (Jena) contributed a paper on photographic sensitivity, and Prof. F. Weigert (Glasgow) on a new time phenomenon in photographic emulsions.

Thermal Decomposition and the Detonation of Solids

Prof. S. Roginski (Leningrad), in a classification of the reactions involving solids, showed that sometimes the chemical and sometimes the crystallization steps determine the course of the reaction. Near equilibrium and when $Q + E$ is small or negative, the processes are governed by crystallographic factors, the rate of reaction in such cases being proportional to the surface area of the grains. The decomposition of hydrates and mercuric oxide (HgO) are good examples of this type. On the other hand, when $Q + E$ is large and the processes are irreversible, the chemical reaction may take control and the reaction penetrate the lattice in an irregular fashion, giving rise to chain reactions. F. R. Meldrum (Bristol) gave an account of the decomposition of nitrogen iodide, which may be of this latter type.

The conditions under which nuclei form and grow on the surface of crystalline solids were dealt with by Prof. W. E. Garner (Bristol), and a distinction was drawn between endothermic and exothermic changes. There is lattice penetration in certain explosives, for example, mercury fulminate, and it is found generally that in the exothermic class, $dp/dt = kp^n$, where $n = 0{\cdot}8$–1, is obeyed instead of the 2/3 power law. This indicates that these reactions are chain reactions, it being maintained by some investigators that the chains are structural in character and by others that they are analogous to the chain reactions occurring in the combustion of hydrocarbons (Semenoff).

A number of phenomena arise when the rates of formation of the new solid phases are slow. Prof. J. Zawadski and Dr. S. Bretsznajder (Warsaw) showed that spurious equilibria (sorption equilibria) are found in the case of zinc and cadmium carbonates which are due to the slow rate of crystallization of the oxides and carbonates. In the case of hydrates, two factors are involved: (1) the retardation of the rate of reaction by water vapour is greater when the new solid phase is amorphous than when it is crystalline; and (2) water vapour catalyses the crystallization of the new phase (Volmer). Dr. J. Colvin and J. Hume (Leeds) discussed the application of these principles to the appearance of metastable hydrates during dehydration, and showed that the tri-hydrate of copper sulphate is produced when conditions are favourable to the crystallization of this phase. They also gave an account of the Topley-Smith effect with $Mn(COO)_2{\cdot}2H_2O$, where a minimum in the rate of dehydration occurs at a water vapour pressure of 0·1 mm. In the course of the discussion, it was agreed that the explanation of this effect given by Volmer, which was based on the above principles, is substantially correct.

* Report of a General Discussion, arranged by the Faraday Society, held in the University of Bristol on April 11–13.

The thermal decomposition of solids of the explosive class passes into a linear propagation of the reaction or deflagration under certain conditions, and the cause of this transition was ascribed to the simultaneous decomposition of a small number of adjacent molecules (Prof. W. E. Garner and Dr. H. Muraour (Paris)). It was pointed out that the linear propagation can arise under conditions where there is a negligible self-heating of the crystals and therefore that the deflagration must be due to some localized event. Dr. W. Taylor and A. Weale (Stevenston), who have studied the initiation of detonation by mechanical shock, put forward a tribo chemical theory of the origin of the detonation wave, ascribing to the action of friction the activation of a number of adjacent molecules which serves as the centre from which detonation can be initiated.

As Muraour pointed out, although the thermal decomposition can pass into deflagration, it is not possible in all cases for deflagration to pass into detonation, and Taylor and Weale ascribed this to the necessity for a critical stress which must be set up before detonation can occur. This critical stress varies in magnitude from case to case, being very small for explosions of the initiating class but possessing a high value in the case of typical high explosives. This stress cannot arise in all cases from the thermal decomposition but can be brought about by initiation with a more sensitive explosive. The view was expressed in the discussion, in which M. Polanyi, W. Jost, W. Payman and J. D. Bernal took part, that under the high pressures in the detonation wave, 350 tons/in.^{2} and more, the molecular compression would be sufficiently high to cause chemical reaction, the effect of the stress being such as to cause the disappearance of the energy barrier separating the reactants from their products. No general conclusion was reached on this matter, it being considered that other factors such as temperature may play some part in the propagation of the wave. Dr. T. Carlton Sutton (London) brought forward evidence in the case of tetryl that the heat of detonation increases step-wise with increasing density of loading.

Layer Lattices in Solid Carbon

The unique electronic structure of the carbon atom which is responsible for its extensive organic chemistry also confers upon solid carbon peculiar properties of considerable interest and fundamental importance. The advent of X-ray methods of studying the solid state has made possible a much deeper insight into the chemical nature and reactivity of black carbon, and the papers discussed in the section of the discussion dealing with this aspect suggested that the near future will witness a rapid development of this solid phase chemistry, which originated with Fredenhagen's discovery of the alkali-graphites some ten years ago.

Already the list of inter-layer lattice compounds is of considerable length, and although the nature of some of the compounds is still somewhat obscure, their further study is likely to give results of considerable importance. Prof. U. Hofmann (Rostock) described the formation of salts of graphite and strong acids. The peculiar step-wise manner in which these salts decompose (similar to the manner in which C_8K passes into $C_{16}K$) suggests that there is a fundamental electronic connexion between the layer planes of the graphite crystal lattice. Prof. O. Ruff (Breslau) put forward certain suggestions concerning the structure of 'amorphous' carbon and discussed the reactions of carbon with oxygen, fluorine, carbon dioxide and with metals. He also exhibited specimens of graphite monofluoride prepared by himself and Bretschneider and demonstrated the decomposition of the substance on warming. The reaction (*Verpuffen*) was very reminiscent of the decomposition of graphitic oxide. Prof. H. L. Riley (Newcastle-upon-Tyne) directed attention to the abrupt changes which occur in the properties of the products of carbonizing various organic substances at temperatures in the neighbourhood of 700° C. He discussed particularly the susceptibility of various carbons to oxidation to chromic-phosphoric acid and the changes which occur in the strength of coke during carbonization. Dr. H. Thiele (Kiel) discussed the oxidation of black carbon in various electrolytes at room temperature, and demonstrated the swelling of a graphite electrode when anodically polarized in concentrated sulphuric acid, and also the peculiar crackling which occurs when a hard carbon electrode is treated in a similar manner. He referred to the various stages in the oxidation: (1) primary oxide, (2) swollen oxide, (3) blue graphitic oxide and graphitic acid and also humic acid.

The problems connected with the kinetics of carbon combustion are likely to become less obscure as our knowledge of the chemical nature of black carbon increases. In spite of extensive experimental work, the exact mechanism of carbon oxidation is still obscure. Prof. V. Sihvonen (Helsingfors) discussed the influence of keto- and ketene groups and of adsorbed molecules and ions and the mechanism of carbon oxidation. Basing his views on extensive experimental work on the reduction of carbon dioxide, adsorption of oxygen, combustion in oxygen, effect of water vapour and the anodic oxidation of carbon both in electrolytes and in the gas phase, he advanced comprehensive theories as to the mechanism of the breakdown of the carbon lattice. Dr. Lothar Meyer (Höllriegelskreuth, near Munich) described some of his ingenious experiments on carbon combustion at low pressures. The technique employed, following the static experiments of Langmuir, consists in streaming the oxidizing gas at a pressure of a few thousandths of a millimetre of mercury, at a high velocity, over a carbon filament heated electrically, so reducing considerably the chances of secondary reactions occurring. The results obtained with oxygen, carbon dioxide, and water vapour were described. The part played by surface oxides in the oxidation of carbon was discussed by Dr. R. F. Strickland-Constable (Oxford). Although the exact nature of the oxide is still uncertain, there appears to be little doubt that some form of solid oxide plays an important intermediate part in carbon combustion. The views of Rhead and Wheeler put forward twenty-five years ago, and the recent views of Eucken on the mechanism of carbon combustion, support this idea. Strickland-Constable also described experiments on the oxidation of carbon in nitrous oxide. J. D. Lambert (Oxford) discussed briefly the effect of certain metals on the oxidation process.

The paper by Prof. E. Berl (Pittsburgh) on the formation and properties of activated carbon was taken as read. Only a very limited time remained for discussion.

Dominion Tributes to Lord Rutherford

TRIBUTES to Lord Rutherford continue to appear, written in many cases subsequent to the numerous appreciations in NATURE. Prof. T. H. Laby, professor of natural philosophy in the University of Melbourne, has published an article in the January number of the *Australian National Review*. Dr. C. M. Focken, lecturer in physics at the University of Otago, N.Z., has given a good summary (19 pp.) of Rutherford's life and work (Otago: N.Z. University. London: Whitcombe and Tombs, Ltd.). Dr. E. Marsden, now Director of the New Zealand Department of Scientific and Industrial Research, has written an interesting account of Rutherford's origin and youth in the *New Zealand Railways Magazine* for January and February, 1938.

The chief feature of these contributions is the insistence on the great benefits to the Dominions of Rutherford's visits and influence. Prof. A. Norman Shaw, of McGill University, has already pointed out that physics acquired a new status in Canada dating from that period when Rutherford 'set the St. Lawrence on fire' at the beginning of the century. During the visit of the British Association to South Africa, Rutherford spoke at several of the colleges, and the gratitude conveyed to him always expressed fresh interest and stimulation. In Australia and New Zealand his lecture tours were semi-regal, and Rutherford endeavoured in vain to curb the enthusiasm which would manifest itself in functions, students dragging his car, and even mayors and brass bands. The fact is that wherever he went—Europe, America or the Antipodes—he was one of Great Britain's best ambassadors.

Rutherford was aware, from personal experience, of the difficulties which most physicists have to face in working in the Dominions, sometimes rather isolated, with a shortage of co-workers to discuss developments, and with delay in acquiring information and delay in publication of results.

As Prof. Laby writes: "Although he left New Zealand as a young graduate, Rutherford never forgot his native land, and he rendered it many scientific services. This attitude was expressed, too, in the numerous connexions which he maintained with physicists in the Dominions: the many helpful letters which he wrote to them must have been no small tax on his energies. His experience in Canada, his visits to Australia, New Zealand and South Africa, gave him a quite rare perception of the difficulties of scientific work in the Dominions. He went to great pains to accept in his laboratory research students from the Dominions, and few were so quick to recognize in them real ability, if they possessed it, than he. . . . It is conventional to speak of the loss which a man's death creates, but it is no mere tribute of that kind to say Rutherford's death is a very real loss to physics in the Dominions."

So, too, Dr. Focken: "Although he was essentially modest and unassuming, his dominating presence commanded success. In view of his tremendous energy and blazing intellectual fire, it is not at all surprising that he got things done. . . . It is related that his students after a period of fear, learned to love and respect him. His enthusiasm infected them. Once a day he walked round the whole laboratory to talk to each student and discuss difficulties which had arisen and possible lines of advance in the student's research. He spoke of his forty or fifty students as his family, to whom he acted as 'father, grandfather and mother'. He was always pleased to take into his laboratory any young men from the Dominions who had had proper training, provided he had the accommodation. At one time he had so many of these students that he could not accept any from foreign countries. I recall his generosity in offering to allow me to work in his laboratory for a brief period at a time when he had many other applications from students willing to stay longer. Just as generations of overseas students at Oxford took delight in the open house kept on Sunday afternoons by Sir Charles and Lady Sherrington, so at Cambridge, students who attended the Cavendish Laboratory recall with great pleasure the informal tea parties in the Rutherford home."

Dr. Focken also mentions several interesting facts relating to Rutherford's early life which are not well known in Great Britain. His father, James Rutherford, was born a century ago in Perth, Scotland, and was taken by his parents to New Zealand while still a child. He became a wheelwright like his father and in 1866 married Martha Thomas. Ernest Rutherford was the fourth child of twelve and was born at Nelson on August 30, 1871. The family afterwards moved to Havelock, twenty-five miles east of Nelson and worked "an outback farm". From the age of eleven to sixteen, Ernest attended the Havelock school under Mr. Jacob Reynolds and won a provincial scholarship tenable for two years at Nelson College. Here he won many prizes, became dux of the College and gained a Junior University scholarship at Canterbury College, Christchurch. In 1893 he took his M.A. degree with first-class honours in mathematics and physics and next year was awarded an 1851 Exhibition Science scholarship with which he entered Cambridge in 1895. At Christchurch under Prof. Bickerton he constructed a magnetic detector of wireless waves, took a prominent part in debate and as a forward in the football team. According to a fellow pupil at Nelson and Christchurch, Mr. F. Milner, who contributes a foreword to the pamphlet, "whatever Rutherford did as a student he did thoroughly".

Dr. E. Marsden was one of the distinguished band of research students working at Manchester with Rutherford: "Geiger and Marsden made the very striking observation that some of the particles incident on a sheet of matter have their direction changed to such an extent that they emerge again on the side of incidence." ("Radiations from Radioactive Substances", p. 191.) This result started Rutherford on his successful voyage to the nucleus!

Marsden accompanied Rutherford on his last tour in New Zealand and made all arrangements for travel, meetings and lectures. He has written a good account of Rutherford's youth and given an appreciation of the enormous influence his life and work, his visits and lectures have had on the people of New Zealand.

Mr. R. M. Laing has contributed a brief article to *To-morrow*, a New Zealand independent fortnightly (Nov. 10, 1937).

The *Nelsonian*, the magazine of Rutherford's school, Nelson College, has collected notices and published a photograph of the old Rutherford home since demolished. One of the Houses at Nelson College is now known as Rutherford House.

Dr. C. M. Focker is also preparing a full bibliography of the publications of Lord Rutherford to be given in the *Transactions of the Royal Society of New Zealand*. The list is still incomplete, but the present number of books, letters and articles has already reached a total of some two hundred and sixty. It will be a valuable index of Lord Rutherford's activities.

The Assessment of Nutrition

IT is not often that a single problem is, at one time, and without deliberate co-ordination, studied by medical men, scientific workers and sociologists. This is the case with the 'assessment of nutrition'. Everyone who is interested should read a contribution* which both shows how urgent the problem is and (by implication, since the author tactfully understates his case) indicates possible modes of solution. Everyone should also read the discussion which follows the paper.

Mr. Huws Jones defines the problem: To discover undernourished children that they may be fed. There is reason to believe the methods in use are not discovering them all. Three possible improvements are suggested; more frequent detailed medical examination, frequent rapid survey to select cases for detailed examination, or the use of a physical yardstick to select cases for detailed examination. Since questions of finance exclude the first suggestion (yearly examination of all children would mean trebling the number of school medical officers), and the second is not considered likely to be useful, attention is concentrated on the third.

The object of the inquiry was to show whether any system of physical measurements can be used to avoid unnecessary extension of medical examination, to select probable cases for the decision of the medical officer. School children were therefore medically examined and carefully measured. Children from the same school were examined by the same doctor on two occasions; the same children were examined by different doctors; the doctors "were urged to take as much time as they wanted over the assessment of each boy". Finally, the grading of the children by physical measurement and by medical opinion was compared.

The comparison showed that the percentage of children graded by medical examination as subnormal increased steadily from good to poor schools; that height and weight, at each age, improved with social class; that of children graded medically in the same nutrition class those in better schools were taller and heavier than those in poorer schools, and that height and weight in all classes of school improved with nutrition class. Nutrition grades, as determined by medical examination, "are distinguished best by weight, then by chest, and finally by height". But no combination of measurements could be found which could be used to pick out exactly the same children as the medical officers would select as a result of their examination.

The discussion is illuminating. Dr. Magee ignored the economic reason for seeking a time-saving substitute for clinical examination and wished to combine anthropometric with clinical examination and even add on physiological tests. Dr. Glover, of the Board of Education, cheerfully delivered himself into the hands of his critic on two counts, first that the discrepancies between the assessments of the different medical men could be explained as due to borderline cases, and second that the judgment of "teachers, school nurses, school attendance officers and others in regular contact with the children . . . could go far towards filling any gaps left by clinical assessment".

From the former of these suggestions, Mr. Huws Jones deduced that, in some areas, more than half the children examined were on the borderline between satisfactory and unsatisfactory nutrition, which makes the published reports of the Board seem "Too rosy". In view of the second, he wondered what need there is to employ medical men at all for this purpose if teachers appear to be so successful in picking out children who escape the doctors' scrutiny.

Dr. Daley suggested that the important thing was, not the anthropometric measurements at a given moment, but periodic measurements to show rate of growth.

Apart from the general conclusion that physical measurements give an index "at least as satisfactory as a careful and complete clinical examination", the issue is left in doubt. Indeed, Mr. Jones himself questions whether the best index he found (Tuxford's) can be regarded "as a satisfactory measure of nutrition". But, if the problem be accepted as originally enunciated, namely, to discover undernourished (that is, underfed) children in want of more food, then, on analogy with animal husbandry, physical measurements are the simplest and only reliable criteria. If, on the other hand, as appears from several parts of the discussion, something more difficult and subtle must be read into the problem, which becomes a complicated mixture of questions of disease and *mal*nutrition, as well as underfeeding, then the role of the doctor appears to be to select from amongst those shown by physical measurement to be below an accepted standard: (*a*) those whose condition is referable to any detectable disease condition not nutritional in origin; and (*b*) those suffering not from gross lack of food, but from some particular deficiency. The first would receive appropriate treatment and all the others would be fed; unless, of course, as Mr. Jones rationally suggests—and his study has given a general indication in favour of this solution—all the children from poor families are fed.

* Jones, R. H., "Physical Indices and Clinical Assessments of the Nutrition of Schoolchildren" (with Discussion), *J. Roy. Statist. Soc.*, **101**, 1–52 (1938).

Science News a Century Ago

Thomas Andrew Knight, F.R.S., 1759-1838

ON May 11, 1838, Thomas Andrew Knight, the plant physiologist and horticulturalist, died in London at the age of seventy-nine years. Born at Wormsley Grange near Hereford on August 12, 1759, he entered Balliol College, Oxford, in 1778, and being in possession of ample means was free to follow his own inclinations. His physiological investigations began with inquiries as to the circulation of sap, on which it has been said he "did much that was not only instructive for the time", but "was destined to remain with little modification among the fundamental facts of science". His most important work related to the growth of plants and their environment. In his study of the germination of seeds he used a revolving water-mill wheel on the edge of which he placed the seeds. He found that the shoots, no matter how they were pointed at first, gradually turned their points outwards from the circumference of the wheel, while the radicles grew inwards. In 1795 he read a paper to the Royal Society on the inheritance of disease of fruit trees and the propagation of debility by grafting. This paper was succeeded by accounts of experimental researches into vegetable fecundation, the ascent and descent of sap in plants, the phenomena of germination, the influence of light upon leaves, and a great variety of similar subjects. Knight was an original member of the Horticultural Society founded in 1804. In 1805 he was elected a fellow of the Royal Society and in the following year was awarded the Copley Medal. In 1811 he succeeded Sir Joseph Banks as president of the Horticultural Society, founded in 1804, and held office until his death. The Knightian Medal was founded in his honour. He was "a man of great patience and great perseverance, and seems to have had a charming personality, warm-hearted and generous, a little hasty at times, but of great kindness". His "Physiological and Horticultural Papers" were published in 1841, with his Life prefixed. In addition to numerous papers in the transactions of the Horticultural and Linnean Societies he was the author of "A Treatise on the Culture of the Apple and the Pear", "The Manufacture of Cider and Perry" (1797) and "Pomona Herefordiensis" (1811).

National Standards of Length and Weight

IN his autobiographical notes for 1838, Airy wrote: "The National Standards of Length and Weight had been destroyed in the fire of the Houses of Parliament (Oct. 16, 1834). On May 11th I received a letter from Mr. Spring Rice, requesting me to act (as chairman) with a committee consisting of F. Baily, J. E. Drinkwater Bethune, Davies Gilbert, J. G. S. Lefevre, J. W. Lubbock, G. Peacock, and R. Sheepshanks, to report on the steps now to be taken. I accepted the charge, and the first meeting was held at the Observatory on May 22nd; all subsequent meetings in London, usually in the apartments of the Royal Astronomical Society, I acted both as chairman and as working secretary. Our enquiries went into a very wide field, and I had much correspondence."

This was the beginning of the long and laborious investigations and experiments which led to the construction of the new standards. Most of the work was done by Baily, who died in 1844, and Sheepshanks, who died in 1855, the day before the Royal Assent was given to "an act for legalising and preserving the last standards of weights and measures". This act provided that "The straight Line or Distance between the Centres of the two Gold Plugs in the Bronze Bar deposited in the Office of the Exchequer as aforesaid shall be the genuine standard of that Measure of Length called a Yard and the said straight Line or Distance between the Centres of the said Gold Plugs or Pins in the said Bronze Bar (the Bronze being at a temperature of Sixty-two Degrees by Fahrenheit's Thermometer) shall and be deemed to be the Imperial Standard Yard".

On June 18, 1857, Airy read to the Royal Society an "Account of the Construction of the New National Standard of Length, and of its Principal Copies."

The history and development of standards of measurement formed the subject of Sir R. T. Glazebrook's Guthrie Lecture to the Physical Society of London on May 15, 1931 (see NATURE, 128, 17, July 4, 1931).

The London and Southampton Railway

UNDER the date May 12, 1838, the *Gentleman's Magazine* recorded, "The works upon The London and Southampton Railway having been so far completed as to permit its being opened to Woking-common, a distance of twenty-three miles from London, the first experimental trip was made, when the Directors, accompanied by their chief engineer Mr. Locke, by several noblemen and by many Members of Parliament, paid a flying visit to the admiring rustics who had congregated in thousands at Woking. The party assembled at the handsome and convenient terminus at Nine Elms, near Vauxhall Bridge. Rolling onwards at an equal but rapid rate Wandsworth and Wimbledon were soon passed; Merton was seen on the left; and in a few minutes Kingston with all its lovely scenery showed itself in the distance. . . . Byfleet and the long and beautiful range of hills which bound the neighbourhood of Leatherhead and Dorking" could be seen, "and a few minutes afterwards the station of Woking-common was gained. The whole distance was accomplished in 45 minutes."

University Events

BIRMINGHAM.—The Huxley Lecture is to be given by Prof. Ernest de Selincourt on May 19 at 5.30 p.m.; he will take as his subject "Literature and Science".

CAMBRIDGE.—The following have been appointed University demonstrators in anatomy: E. W. O. Adkins, of St. John's College; G. D. Channell and F. Wemyss Smith.

It is proposed to confer the degree of Doctor of Science, *honoris causa*, upon F. P. Rous, of the Rockefeller Institute for Medical Research in New York.

OXFORD.—In Convocation on April 26 it was agreed that the honorary degree of D.Sc. should be conferred on July 16 on Dr. Harvey Cushing, emeritus professor of surgery at Harvard University.

ST. ANDREWS.—The Court has appointed Dr. W. F. K. Wynne-Jones, of the University of Reading, to the chair of chemistry in University College, Dundee, which will become vacant on September 30 by the retirement of Prof. Alexander McKenzie. Mr. J. Norman Davidson has been appointed to the vacant lectureship in bio-chemistry in University College, Dundee.

Societies and Academies

Dublin

Royal Dublin Society, March 22, 1938.

PAUL A. MURPHY: A study of the seasonal development of the potato plant in relation to blight attack and spraying. The rate of growth of foliage and tubers was studied on potatoes on which *Phytophthora infestans* was perfectly controlled, commercially controlled, and uncontrolled. The first effect of spraying was generally to check the production of foliage and tubers, and reduce blossoming, but during the drought of 1933 the foliage was increased, as has been found under similar conditions in the United States.

H. H. DIXON: Subaqueous transpiration. This note deals with the criticism of Smith, Dustman, and Sheill, of a paper published by the author in 1898 on transpiration into a saturated atmosphere. The critics repeated the author's experiments with material from several species, always with negative results. They concluded, not realizing the precautions that had been taken, that the early results were due to water-deficit in the experimental material. In the present work, positive results were obtained with branches and leaves which had been kept twenty-four hours submerged and freely supplied with water. The material used by the critics was similarly treated for only one or two hours. Hence the objection of water-deficit cannot be raised. Probably some difference in technique, or in the physiological state of the material, was responsible for the discrepancy.

Paris

Academy of Sciences, March 7 (*C.R.*, **206**, 705–792).

LÉON LECORNU: Cutting a solid body.

PIERRE LEJAY and CHANG HUNG CHI: Measurements of gravity in the south of China. The measurements given were made with the Holweck-Lejay pendulum. In order to avoid the large temperature corrections necessary with this instrument, a field thermostat was devised capable of maintaining a constant temperature for several hours.

WOLFGANG DŒBLIN: Study of the ensemble of powers of a law of probability.

ROBERT FORTET: The resolution of a system of equations of Schrödinger.

HENRI EYRAUD: Certain decompositions in imaginary chances.

MAX ZORN: The lemma of Schwarz.

ERNEST VESSIOT: The equations $F(x,y,z,p,q,r,s,t)=0$ integrable by the method of Darboux.

SZOLEM MANDELBROJT: The applications of a theorem on the arguments of singularities.

AYZYK GORNY: Functions indefinitely derivable on the whole of the real axis.

GEORGES VALIRON: The directions of Borel of meromorph algebroid functions of infinite order.

ARNAUD DENJOY: The singularities of an analytical function defined by an element.

RAYMOND TREMBLOT: The multiple spectroscopic stars 52 and 58 Persei.

THÉODORE KAHAN: Shock between a high-energy neutron and a proton treated by the method of approximation of Born.

MANUEL VALADARES and FRANCISCO MENDES: Study of the $L\alpha$ satellites for the element 82 (Pb).

GUY EMSCHWILLER: The photochemical oxidation of methylene iodide: the production of iodic anhydride. Methylene iodide with oxygen in a closed vessel exposed to ultra-violet light gives iodine, formaldehyde, formic acid, carbon monoxide and iodine pentoxide, the last in appreciable quantity.

RENÉ AUDUBERT: The ultra-violet emission spectrum and slow thermal dissociation of sodium hydrazoate.

FRÉDÉRIC JOLIOT and IGNACE ZLOTOWSKI: The energy of the groups of protons emitted during the transmutation of boron by the α-rays.

MLLE. MARIE THÉODORESCO: The Raman spectrum of some molybdates in aqueous solution.

VICTOR AUGER and MLLE. NINA IVANOFF: Ammonium magnesium arsenate and alkaline earth arsenates.

CHARLES DUFRAISSE and JEAN HOUPILLART: Syntheses in the naphthacene series: naphthacenediaquinone.

BERNARD GÈZE: The genesis of the Quercy phosphorites.

OTTO MUNERATI: The use of rhizogene compounds for favouring the formation of roots and of flower bearing stems on the collars of the beetroot.

ROBERT DOUIN: The photo-geotropic sensibility of the sporogone of the Hepaticæ.

ANDRÉ MIRIMANOFF: Vitamin C and chlorophyll. Determinations of ascorbic acid in various organs of plants by Meunier's method leads to the conclusion that the antiscorbutic value of a plant does not depend on the presence of chlorophyll.

RENÉ SOUÈGES: The embryogeny of the Portulaceæ. The development of the embryo in *Portulaca oleracea*.

RENÉ MORICARD, MLLE. SIMONE GOTHIÉ and BASILE TSATSAIS: The realization of a culture medium deprived of animal matter and allowing the maturation of the ovules of mammals.

JEAN JACQUES BOUNHIOL: The possible role of the frontal ganglion in the metamorphosis of *Bombyx mori*.

MLLE. YVETTE NEEFS: Remarks on the sexual cycle of the sea-urchin, *Strongylocentrotus lividus*, in the Roscoff region.

EUGÈNE AUBEL, WASTROSLAW S. REICH and F. MICHEL LANG: The state of the glycogen in the liver.

MAURICE LECAMP: The regeneration of the limbs in *Carausius morosus*.

EDGAR LEDERER and FRANZ H. RATHMANN: The vitamins A_1 and A_2.

ROBERT PAULAIS: The colorimetric estimation of iron. Application to the analysis of biological substances.

HENRI BIERRY, MARCEL ANDRAC and BERNARD GOUZON: The globulines and reagines of syphilitic sera.

MAURICE DOLADILHE: The antibody property of hæmolysin is exercised by a substance isolable from hæmolytic serum.

Cracow

Polish Academy of Science and Letters, February 7.

T. BANACHIEWICZ: Rotations in space of four dimensions and the two aspects of the equations of spherical polygonometry.

J. PNIEWSKI : Studies on the diffusion of light in the edges of the Rayleigh line in carbon disulphide. The distribution of the intensities of this line observed in carbon disulphide cannot be explained by the Raman theory of diffusion due to the rotation of the molecules.

MLLE. B. TWAROWSKA : The absorption spectra of biacene and fluorocyclene.

D. DOBORZYNSKI : Measurements of the dielectric constant of solids by means of ponderomotive forces.

F. KEPINSKI : The movement of the periodic comet of Kopff (1906 *c*).

W. OPALSKI : Microphotometric measurements of SU Draconis in 1935–1936 and their comparison with preceding measurements.

M. CENTNERSZWER and MLLE. H. LADZINSKA : The lowering of the boiling point of a ternary system by non-volatile substances. (2) Mode of behaviour of cobalt chloride and sodium nitrate in water.

M. CENTNERSZWER and MLLE. K. ZOLATKOWSKA : The lowering of the boiling point of a ternary system by non-volatile substances. (3) Aqueous solutions of calcium nitrate.

M. CENTNERSZWER : The lowering of the boiling point of a ternary system by non-volatile substances. (4) Certain properties of isozeonic solutions.

ST. KREUTZ : The amphibolites of the Tatra.

F. WEILER : Mode of behaviour of roots under the action of growth substances contained in the germs of oats and maize.

Geneva

Society of Physics and Natural History, February 3.

PAUL ROSSIER : Accuracy of measurements with the Thomson bridge. The influence of a difference between the resistances which ought to be equal in the bridge is reduced to a minimum if the connection resistances are made as small as possible, in this way resembling the Wheatstone's bridge.

PAUL ROSSIER : The determination of the coefficients of leak of electrical machines. The addition of supplementary coils, the use of known resistances one of which can be altered, and of an ordinary or differential galvanometer allows a simple determination of this coefficient.

EMILE GUYENOT and KITTY PONSE : Anti-hormonal immunization and specificity. The immunization obtained by a prolonged treatment with prepituitary extracts of the ox, protects the animals against the action of the thyroetrope and crinogen hormones arising from the ox or sheep, animals belonging to the same group, whilst it is without action towards the same hormones of the pig, horse and man. Hence the reaction is specific. Moreover, the immunization appears to be set up not towards common albumens, but with respect to the protein molecules which constitute the hormones themselves.

EMILE CHERBULIEZ and ANNA HERZENSTEIN : The differential estimation of the reducing acids of sulphur. The differential estimation of various reducing sulphur acids in sulphurous waters may be carried out, even at very low concentrations, in the following manner. (1) Determination of the total reducing power by iodine. (2) Determination of hydrogen sulphide or of the sulphides by precipitation with cadmium carbonate or acetate and titration of the precipitated sulphide by iodine. (3) Determination of the thiosulphuric acid or of its salts by iodine, after eliminating sulphuretted hydrogen and an unknown reducing agent by means of potassium iodate in neutral solution. This last reaction is new. The authors have applied the method to Pistany (Czechoslovakia) waters which contain the following reducing sulphur acids : hydrogen sulphide, thiosulphuric acid and an unknown reducing agent which is perhaps hydrosulphurous acid ($H_2S_2O_4$.)

FERNAND CHODAT and PAUL BRUNSCHWIG : New researches on cresol blue (tyrosinase, paracresol, amino acids). The authors have measured the quantity of oxygen fixed in the course of the first phase of the synthesis of cresol blue, and have arrived at the following results. The amino acid has nothing to do with the quantity of oxygen fixed, the latter depending only on the concentration of the oxidizable phenols. Each molecule of paracresol fixes a little less than three atoms of oxygen. The oxidation of the phenol, catalysed by the tyrosinase, is much more rapid in the presence of the amino acid (glycocol).

Moscow

Academy of Sciences (*C.R.*, **18**, No. 1, 1938).

LOO-KENG HUA : Some results in the additive theory of numbers.

I. I. PRIVALOV : (1) Applications of the idea of harmonic measure to certain problems of the theory of functions. (2) Limit problems of the theory of harmonic and subharmonic functions in the space.

S. A. TCHOUNIKHIN : Groups with predetermined subgroups.

I. A. ČARNYI : Theory of unidimensional non-stationary movement of fluid in tubes.

L. SEDOV : Hydrodynamic theory of grid.

P. KAPITZA : Viscosity of liquid helium below the λ-point.

S. N. RSHEVKIN : Possibility of obtaining high coefficients of sound absorption by using systems of resonators.

A. A. GERŠUN : Photometric invariant.

P. A. BOBROV, L. I. KOLOTOVA and V. A. ZAMYATINA : Investigation of decomposition products of lignin.

D. I. RJABTSCHIKOW : Thiosulphate compounds of the bivalent platinum. (1).

D. J. VAKULIN : The problem of the responsiveness of *Lallemantia iberica* F × M to vernalization.

N. S. PETINOV and G. A. ZAK : The problem of the hardening of plants by soil dryness under conditions of irrigation. (1) The effect of hardening on growth and formative processes.

N. S. PETINOV : The problem of the hardening of plants by soil dryness under conditions of irrigation. (2). The effect of hardening on photosynthesis and yield.

A. A. RICHTER and O. K. ELPIDINA : The practice of aerial fertilization with carbon dioxide.

D. A. KOMISSAROV : Application of growth substances to increase the rooting capacity in cuttings of woody plants and shrubs.

N. S. PETINOV : The effect of continuous and discontinuous water supply on the photosynthetic process and the yield of summer wheat.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, May 9

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Capt. H. C. Smith: "On the Frontier of British Guiana and Brazil".

Tuesday, May 10

GRESHAM COLLEGE, Basinghall Street, London, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Astronomy for Surveyors and Navigators". (Gresham Lectures on Astronomy.) (Succeeding lectures on May 11, 12 and 13.)*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting.

Wednesday, May 11

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at the British Academy, Burlington Gardens, W.1), at 8.—Prof. J. Read, F.R.S.: "Alchemy under James IV of Scotland".

Thursday, May 12

ROYAL SOCIETY, at 4.30.—Discussion on Plastic Flow in Metals, to be opened by Prof. W. L. Bragg, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

Dr. A. P. M. Fleming: "The Evolution of Electrical Power" (Faraday Lecture).

Friday, May 13

ROYAL ASTRONOMICAL ASSOCIATION, at 5.—Prof. Charles Fabry: "Interstellar Space" (George Darwin Lecture).

ROYAL INSTITUTION, at 9.—J. M. Wordie: "An Expedition to North-West Greenland and the Canadian Arctic".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN PHYSICS in the University of Sheffield—The Registrar (May 9).

SCIENTIFIC OFFICER (EXPLOSIVES) and JUNIOR SCIENTIFIC OFFICER (METALLURGY) in the Research Department, Woolwich, S.E.18—The Chief Superintendent (May 10).

LECTURER IN MECHANICAL ENGINEERING in the Dudley and Staffordshire Technical College—The Principal (May 12).

TECHNICAL OFFICER and ASSISTANT (II) for RADIO RESEARCH, War Department—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (May 13).

PRINCIPAL TECHNICAL OFFICER (Ref. No. 32 B) and TECHNICAL OFFICERS (Ref. 33 B) in the Aerodynamics Department, Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 13 and May 14 respectively).

AGRICULTURAL BACTERIOLOGIST in the Punjab Agricultural Service (Class I)—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2, by postcard (May 13).

ASSISTANT LECTURER IN MATHEMATICS, with qualifications in applied mathematics, in the University of Manchester—The Registrar (May 14).

ASSISTANT (grade II) for aircraft instrument work at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent, quoting Ref. No. 37 B (May 14).

A TECHNICAL OFFICER (Ref. 20 B), an ASSISTANT (grade I; Ref. 21 B), an ASSISTANT (grade II; Ref. 22 B), an ASSISTANT (grade III; Ref. 23 B) for electrical equipment work at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 14).

LECTURER IN BACTERIOLOGY in the University of Birmingham—The Secretary (May 14).

ASSISTANT FIELD SUPERVISOR at the Norfolk Agricultural Station—The Director (May 14).

ASSISTANT LECTURER IN CHEMISTRY in the Technical College, Bradford—Director of Education, Town Hall, Bradford (May 14).

ASSISTANT LECTURER IN CHEMISTRY in the Technical College, Bradford—The Principal (May 14).

LECTURER IN PSYCHOLOGY in the Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

EXAMINER IN THE PETROLEUM LABORATORY and WOMEN EXAMINERS IN THE NON-METALLIC SECTION of the A.I.D. Test House, Kidbrooke, London, S.E.3—The Secretary, Air Ministry, Kingsway, London, W.C.2 (quote I.G. 10 and I.G. 11 respectively).

ASSISTANTS (grade III, male) in the Meteorological Office, Air Ministry—The Secretary (S.2A), Air Ministry, Adastral House, Kingsway, W.C.2.

ASSISTANT CIVIL ENGINEERS in the Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief, marked "A.C.E. April".

ASSISTANT CIVIL ENGINEERS in the Air Ministry—The Secretary (W.9), enclosing addressed envelope.

ASSISTANT in the Intelligence Section of the MINERAL RESOURCES DEPARTMENT, Imperial Institute—The Establishment Officer.

JUNIOR SCIENTIFIC OFFICER at the Low Temperature Research Station, Cambridge—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1 (postcard quoting J.38/4).

LECTURER IN THE MATHEMATICS DEPARTMENT of Heriot-Watt College, Edinburgh—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

World Power Conference. Annual Report 1937. Pp. 15. (London: World Power Conference.) [204

British Museum (Natural History). Instructions for Collectors, No. 13: Alcohol and Alcoholometers. Second edition. Pp. 13. (London: British Museum (Natural History).) 3*d*. [224

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 59: The pH of Conifer Leaves in relation to Systematy. By O. Roberts and Dr. J. Doyle. Pp. 655–674. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s*. [224

Iron and Steel Institute. Special Report No. 20: The Application of Time Study to Rolling Mills. By the Rolling Committee of the Iron and Steel Industrial Research Council. (Rolling Mill Committee Report No. 2.) Pp. viii+130. (London: Iron and Steel Institute.) [234

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 774, Vol. 237: On the Forces acting between Atoms and Ions and the Physical Properties of Matter in Bulk. By J. A. Wasastjerna. Pp. 105–134. 4*s*. No. 775, Vol. 237: Investigations on Magne-crystallic Action. 5: Paramagnetic Salts of the Rare Earth and the Iron Groups. By Prof. K. S. Krishnan and A. Mookherji. Pp. 135–159. 3*s*. 6*d*. (London: Cambridge University Press.) [234

Statutory Rules and Order, 1938, No. 299: Public Health, England. Aircraft Regulations, 1938. Pp. 17. (London: H.M. Stationery Office.) 5*d*. net. [254

Other Countries

The Rockefeller Foundation. A Review for 1937. By Raymond B. Fosdick. Pp. 62. (New York: Rockefeller Foundation.) [194

U.S. Department of the Interior: Office of Education. Leaflet No. 32: Personnel and Financial Statistics of School Organizations serving Rural Children, 1933–34. Prepared by Lester B. Herlihy. Revised by Emery M. Foster and Katherine M. Cook. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents. [194

Expédition Antarctique Belge. Résultats du Voyage de la *Belgica* en 1897–99: Rapports Scientifiques. Zoologie: Siphonophores et Cténophores. Par Eugène Leloup. Pp. 12+1 plate. (Anvers: J.-E. Buschmann.) [204

Bureau of Education, India. Education in India in 1935–36. Pp. vii+139. (Delhi: Manager of Publications.) [214

Jamaica. Annual Report of the Department of Science and Agriculture for the Year ended 31st December 1936. Pp. ii+92+11+1 plate. (Kingston, Jamaica: Government Printing Office.) [214

Miscellaneous Publications of the Royal Alfred Observatory. No. 17: The Cyclone Season 1934–35 at Mauritius. By M. Herchenroder. Pp. 6+41 plates. (Port Louis: Government Printer.) [214

Advisory Committee on Education. Report of the Committee, February 1938. Pp. xi+243. (Washington, D.C.: Government Printing Office.) 35 cents. [224

University of Denver: Department of Anthropology. The Archæological Survey of the High Western Plains. Tenth Report: The Black's Fork Culture of Southwest Wyoming. By E. B. Renaud. Pp. 54+12 plates. (Denver, Col.: The University.) [254

U.S. Department of Agriculture. Miscellaneous Publication No. 273: Insect Enemies of Western Forests. Compiled by F. P. Keen. Pp. 210. (Washington, D.C.: Government Printing Office.) 25 cents. [254

Occasional Papers of Bernice P. Bishop Museum. Vol. 13, No. 10: A Check List of the Syrphidæ of Oceania. By Frank M. Hull. Pp. 79–87. Vol. 13, No. 15: A New Species of Hawaiian Portulaca. By Frank E. Egler. Pp. 167–170. Vol. 13, No. 16: A New Species of Trisetum and a New Variety of *Panicum imbricatum* from the Hawaiian Islands. By Leo D. Whitney. Pp. 171–174. Vol. 13, No. 17: Ecological and Floristic Studies in Kipapa Gulch, Oahu. By Edward Y. Hosaka. Pp. 175–232. Vol. 13, No. 18: Liliaceæ of South-eastern Polynesia. By Carl Skottsberg. Pp. 233–244. Vol. 13, No. 19: Some Rubiaceæ of Southeastern Polynesia. By F. Raymond Fosberg. Pp. 245–293. Vol. 14, No. 1: An Open Bog on Oahu; Descriptions of two new varieties of Styphelia and Lobelia. By F. R. Fosberg and E. Y. Hosaka. Pp. 6. (Honolulu: Bernice P. Bishop Museum.) [254

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 43, Part 1: Studies on the Agaricaceæ of Hokkaido, 1. By Sanshi Imai. Pp. 178+3 plates. (Sapporo: Hokkaido Imperial University; Tokyo: Maruzen Co., Ltd.) [254